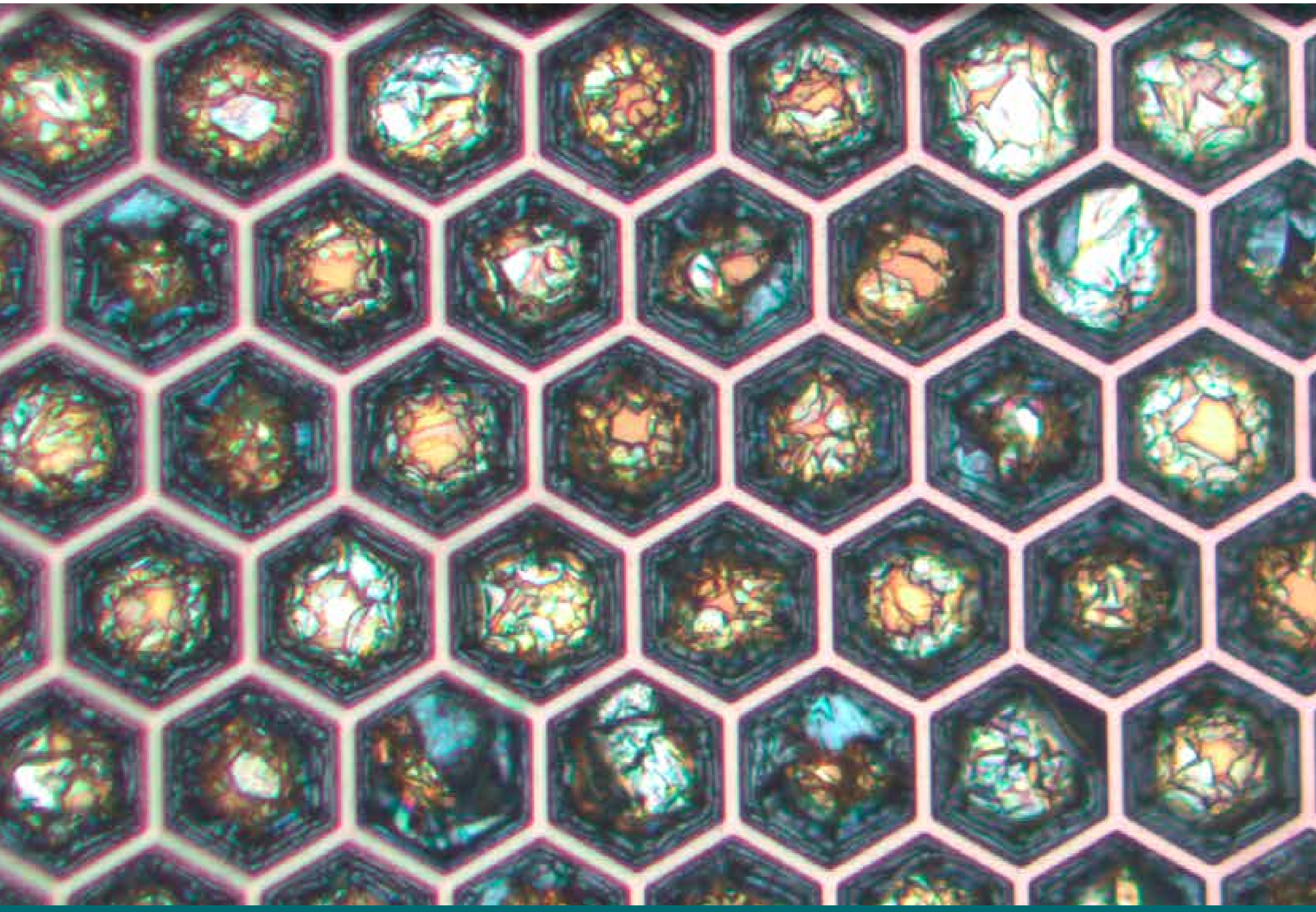
# Tel Aviv University Center for Nanoscience & Nanotechnology

SCIENTIFIC REPORT 2017



Tel Aviv University
Center for Nanoscience
& Nanotechnology

Tel Aviv University Center for

Nanoscience & Nanotechnology

Powering Innovation

Tel Aviv University
Center for Nanoscience
& Nanotechnology

# Center for Nanoscience & Nanotechnology

## SCIENTIFIC REPORT

December 2017

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# OVERVIEW

Tel Aviv University's Center for Nanoscience and Nanotechnology was established in 2000, as the first Israeli institute of its kind. Today, with over 90 affiliated research groups, it is one of the largest and most influential centers on campus. Employing its own professional staff of researchers and scientists, it runs a state-of-the-art central facility, and organizes international schools with leading researchers, as well as student exchange events and seminars. With 16 ERC grantees, to date, the Nano Center's researchers set new standards of excellence and innovation.

Pioneering a novel multidisciplinary approach, the Center houses a variety of laboratories from entirely different domains, all working side by side under one roof. In addition, it has established strong, longstanding ties with industry, providing extensive services to a growing number of companies - from small startups to large corporations. 17 years of constant growth have thus positioned the Center as an important asset to both the TAU research community and the Israeli Industry.

We hope you will find the information in this Report useful for identifying new partnerships, resources and ideas. Comprehensive and constantly updated information about the Nano Center is available on our website at www.nano.tau.ac.il.

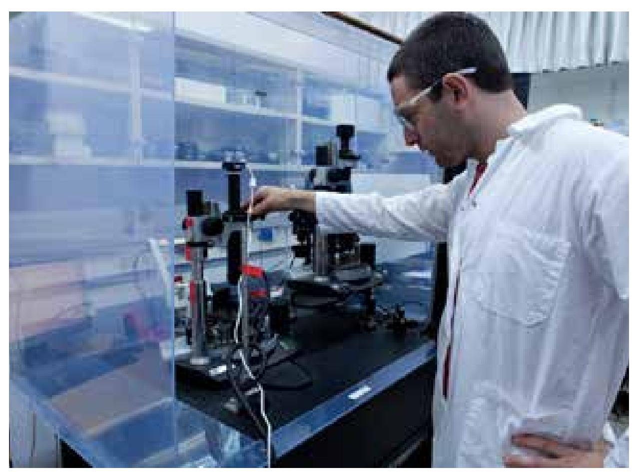
# Hubs of innovation

## The Micro & Nano Characterization & Fabrication Facility (MNCF)

Tel Aviv University's Micro & Nano Characterization & Fabrication Laboratories are the leading facilities of their kind in Israel, providing R&D services to both academia and industry. More than 50 academic groups and over 40 companies – from large Israeli corporations to small startups in their earliest stages - currently use the professionally managed Laboratories, which offer outstanding infrastructures (thanks to a multimillion dollar investment by both the Israeli government and TAU).

The Labs' process engineers offer researchers and corporations comprehensive prototype development services, from small-scale predefined runs to large R&D projects and full-process development, conducted jointly with the customer. Services - including characterization, device design, mask preparation, sample fabrication and backend – are continually improved and expanded, as we add standard operating procedures for more systems, and offer these operating procedures online.

The Nano Center's equipment is among the most advanced and comprehensive in Israel, spanning many types of fabrication methods, and enabling the development of full-process prototypes. Capabilities and technologies at the Labs include mask design and fabrication, optical lithography and e-beam lithography, as well as backend techniques such as wire bonding and dicing. Our new laser-cutting and machining system is the first of its kind in Israel. Additional purchases over the past two years included: a new E-beam Evaporator and Magnetron Sputter, both from Vinci Tech, France; an Electroplating System for Cu, Ni, and Pt electrodeposition from Yamamoto Corp., Japan; and a TFS200 Thermal/Plasma Atomic Layer Deposition (ALD) tool from BENEQ, Finland – all installed and operational at the Center. Another recent addition is RAITH150 Two, a state-of-the-art Ultra High Resolution Electron Beam Lithography system, which enables the realization of structures smaller than 5 nm, working with sample sizes that range from a few mm to 8-inch wafers. The system stability required for demanding exposures is made possible even in difficult environments, by a thermally stabilized and environmentally tolerant shield.



Another important role of MNCF is training TAU scientists and students, as well as external users, to familiarize them with the sophisticated labs and equipment. Running standardized training routines since 2007, we presently continue our effort to film training sessions on specific machines in collaboration with the EU's TEMPUS project (http://edunano.eu/).

# International Collaborations

## XIN Center

In 2014 the elite Chinese University Tsinghua (THU) of Beijing teamed with Tel Aviv University to launch XIN Center, a joint venture aiming to power innovation via ties between top Chinese and Israeli researchers in the fields of Nanoscience and Nanotechnology.

The XIN (meaning New in Chinese) Center focuses on collaborative, high-impact applied research, promoting over a dozen applied research programs at both TAU and THU. A unique mentoring system is applied, whereby leading scientists, industrialists and business figures accompany projects throughout all stages of research, combining internal and external resources from both Israel and China. Emphasis is placed on projects conducted jointly by researchers from both universities. Current examples include: 'Diagnostics and prognosis of cancer and other diseases using the CRISPR system' (Dr. Yuval Ebenstein & Prof. Ting Zhu); and 'Small molecules for treating Parkinson's Disease (Prof. Daniel Segal & Prof. Yan-Mei Li).

Two joint ISF-NSFC grants for collaborating TAU and THU researchers, who had joined forces through the XIN Center, were approved for 3-year funding starting at the end of 2016: Prof. Daniel Segal of TAU and Prof. Yan-Mei Li of THU won the grant for research on 'Rationally designed glycosylated amino acids as modulators of amyloid aggregation in Alzheimer's Disease'; and Prof. Itai Benhar of TAU and Prof. Xin-Hui Xing of THU won the grant for research on 'Choosing sides for antibody-low-molecular-weight-heparin conjugates applied as novel drugs for treating Inflammatory Bowel Disease'.

Over a dozen PhD students and post-doc researchers from both universities have already participated in exchange visits. In addition, MSc students from TAU participated in 'Experiencing China – Tsinghua Summer School 2017', which took place in Beijing, July 16-29, 2017; More recently, PhD students from TAU were hosted by THU's research laboratories.

A delegation of 20 researchers, PhD students and top executives from TAU took part in the 2017 XIN Forum, held at Tsinghua University, September 13-14. More than one hundred experts, entrepreneurs, investors and government officials attended the Forum, exchanging views and conducting in-depth discussions on technological innovation and cooperation between China and Israel.


## Germany-Israel Academia-Industry Nanotechnology Grants

In 2017 Israel and Germany set up a new three-year €30-million plan to promote joint nanotechnology initiatives, calling upon companies and institutions in both countries to submit proposals for funding for projects in this field. Initially supporting 13 joint projects, the program aims to boost cooperation between nanotechnology companies and research centers in Israel and Germany. Five TAU researchers affiliated with the Center - Prof. Yossi Rosenwaks, Prof. Natan Shaked, Prof. Yael Hanein, Prof. Yuval Ebensein and Dr. Ariel Ismach - won five of the initial 13 grants.

## Beijing Institute of Technology (BIT)

In 2016 TAU signed a collaboration agreement with BIT, one of China's leading universities. Since then joint research projects have been established, mainly on nano-energetic materials. A special 'Tel Aviv University Day', held at the BIT campus in Beijing on September 12th 2017, provided TAU scientists with a unique opportunity to introduce their research to BIT lecturers and students.

## Northwestern University

In 2017 three TAU PhD students conducted research at Northwestern University, USA – through a grant provided by the two universities' longstanding exchange program, established in 2007. Collaboration continues, and travel grants for graduate students are awarded annually.

# Educational Activities

Tel Aviv University Center for Nanoscience and Nanotechnology organizes a range of social and scientific activities, including an annual workshop, monthly seminars, monthly Nano-Beer events, student exchange programs and more. Major activities in the years 2016-2018 include:

## IEEE – Gertner Summer School on Nanomedicine

### June 2016, Tel Aviv University

TAU Center for Nanoscience and Nanotechnology was the proud winner of the first Summer School grant from IEEE Nano. The special Summer School for graduate students, also supported by a generous donation from the Gertner Institute, offered intensive training in nanomedicine. Organizers were Prof. Yael Hanein, Prof. Dan Peer and Prof. Tal Dvir.


## Winter School on Emerging Applications of Optical Nanostructures

### 19-23 February 2017, Tel Aviv University

Over a hundred students and lecturers from Tel Aviv University, UK Universities, Tsinghua University and other leading academic institutions in Israel and overseas, took part in this special Winter School. Special guests included Prof. Michael Berry from Bristol University, Prof. John Pendry from Imperial College and Prof. Martin Wegener from the Karlsruhe Institute of Technology. Novel topics presented and discussed were: Nano Devices, Metamaterials and Metasurfaces, Transformation Optics, Extreme Nanoscale Plasmonics, Nanoscale Light-Matter Interactions and Bio-Nanophotonics. The Winter School was organized by Prof. Ady Arie and Prof. Koby Scheuer, under the umbrella of the UK-Israel Shaoul Fund, the Mortimer and Raymond Sackler Institute of Advanced Studies and XIN Center.

## The Fred Chaoul TAU 11th Annual Nano Workshop

### March 2017, the Dead Sea

Over one hundred TAU students and researchers presented their recent research projects and enjoyed a range of social activities during this 3-day Workshop. Prof. Peter Seeberger (Max Planck Institute of Colloids and Interfaces, Germany) gave a guest lecture on 'Automated Glycan Assembly: Basis for Carbohydrate Nanotechnology, Vaccines, Diagnostics and Material Science'. The Workshop was organized by Prof. Natan Shaked and Dr. Vered Padler-Karavani of Tel Aviv University.

## UK-Israel Summer School on Nanoscale Crystallography for Bio and Materials Research

### June 2018, Tel Aviv University

This Summer School will be devoted to crystallographic characterization required for nanotechnology research, offering a balanced view of nanoscale structural characterization for both the life sciences and materials science. The scientific program emphasizes nanoscale characterization via electron microscopy (TEM and SEM) and related methods. The Summer School's organizers are Dr. Zahava Barkay and Prof. Amit Kohn of Tel Aviv University and Prof. Ben Britton of Imperial College.

## Nano Seminars

The Nano Center organizes monthly seminars, bringing in guest lecturers from other universities worldwide, who present cutting-edge innovations to our staff, affiliates and students.

## Intersecting Pathways

In 2014 Tel Aviv University Center for Nanoscience and Nanotechnology and the Amit Foundation established the Intersecting Pathways project, bringing together outstanding Torah scholars and top academic scientists for a joint learning experience on Science and Ethics. The project builds a unique and surprising bond that facilitates curiosity, friendship and scholarship. Over 30 such meetings have already taken place, attracting more than 40 frequent attendees.

## School Visits

The Nano Center regularly hosts and guides groups from k-12 schools from all over Israel, in order to enrich knowledge on nanotechnology and promote scientific excellence among the country's younger generation. At TAU's advanced nano facilities our young guests view cutting-edge experiments from the forefront of modern science.

# A New Building for Tel Aviv University's Center for Nanoscience & Nanotechnology

To fulfill the growing needs of both the Center and Tel Aviv University's research community, a new Nano Building has been designed by well-known French Architect Michel Remon. With its original metal/polymeric shell, resembling the nano-structure of a symmetric nano-fabric, the building will form a spectacular new entrance to the University - right next to Gate 2, below the Diaspora Museum (Beit Hatfutsot).

The modern 7,000m$^2$ building will include a basement, an entrance floor and two upper floors. The entrance floor will house the Nano Characterization & Fabrication Laboratory (about 600m$^2$ of clean rooms), alongside offices; the upper floors will include 16 core research laboratories, a 100-seat auditorium, offices and team rooms; and the basement will contain facility rooms and a sub-fab stabilizing the state-of-the-art devices of the Nano Characterization & Fabrication Laboratory.

Altogether, about 120 engineers and researchers from both academia and industry will use the building as their main hub. A special space will be dedicated to collaboration between the Center's researchers and their guests. Also accessible to the general public, the building will invite visitors from the community to experience cutting-edge science firsthand.

# Research Collaborations with Industry in Israel and Abroad

## New Ventures

New startup companies based on the innovations of researchers from the TAU Nano Center are constantly being established. Following are several new ventures:

- Nanolock Security (Prof. Slava Krylov) – Cyber security for memory cards and SSDs - established in 2017, raising $4.5M
- Unispectral Ltd. (Prof. Slava Krylov and Prof. David Mendlovic) - A sequential color imaging scheme and its implementation in compact camera modules
- QuLab Medical Ltd. (Prof. Fernando Patolsky) - Multiplex real-time monitoring of cellular metabolic activity in physiological solutions using a Redox-reactive nanowire biosensor
- CliniCrowd (Prof. Daniel Segal) - An entity and website for crowd monitoring of the use of Mannitol for treatment of Parkinson's Disease
- Pntlloxx Ltd. (Prof. Ehud Gazit) - Peptide nanotubes for energy storage applications
- Optomechanic Cube Ltd. (Prof. Haim Suchowski) - 3D modular optics for 3D optical alignment

## Agreements with Industry

A considerable number of TAU nanotechnologies have been transferred to industry through license/assignment agreements. In 2017 these included:

- 3PEMS Ltd. (Prof. Yosi Shacham) - 3D-printed electromagnetic systems for RF applications
- BIOSYNTH AG (Prof. Doron Shabat) - Chemiluminescent probes for diagnostics and in-vivo imaging
- Tracense Systems Ltd. (Prof. Fernando Patolsky) – Nano-nose for explosives detection
- Sepal Pharma (Prof. Dan Peer) - Drug delivery via sublingual administration
- Semiconductor Research Corporation SRC, Intel Corporation (Prof. Fernando Patolsky) - Synthesis conversion to high phosphorus nitride thin films

# Recruiting Affiliates and Post Docs

The TAU Nano Center benefits from a vibrant community of nearly one hundred excellent principle investigators and their teams. Over 30 of our affiliates are new recruits who joined Tel Aviv University in the past decade, primarily through the resources put forward by the Israel National Nanotechnology Initiative (INNI). Five researchers from the US, Israel, India and China were recruited over the past year through the Nano Center's post-doc program.

# RESEARCHERS

(Sorted by Last Name)

# Dr. Lihi Adler-Abramovich

**Affiliation:** Faculty of Medicine
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## Research Title

**Bioinspired materials & nanotechnology**

## Selected Publications

1. Guterman T., Kornreich M., Stern A., Adler-Abramovich L., Porath D., Beck R., Shimon L., Gazit E., Formation of bacterial pilus-like nanofibres by designed minimalistic self-assembling peptides, Nature Communications 7, 2016
2. Brahmachari S., Arnon A Z., Frydman-Marom A., Gazit E., Adler-Abramovich L., Diphenylalanine as a reductionist model for the mechanistic characterization of β-amyloid modulators, Nature Communications 8, 14018
3. Shekhter Zahavi T., Oron-Herman M., Kostenich G., Rub E., Salitra Y., Buzhansky L., Orenstein A., Gazit E., Adler-Abramovich L., Molecular engineering of somatostatin analogue with minimal dipeptide motif induces the formation of functional nanoparticles, ChemNanoMat 2017, 3,27–32C
4. Adler-Abramovich L., Marco P., Arnon Z., Creasey R., Michaels T., Levin A., Scurr D., Roberts C., Knowles T., Tendler S., Gazit E., Controlling the physical dimensions of peptide nanotubes by supramolecular polymer coassembly, ACS Nano, 2016, 10 (8), pp 7436–7442F.
5. Arnon Z., Vitalis A., Levin A., Michaels T., Caflisch A., Knowles T, Adler-Abramovich L., Gazit E., Dynamic microfluidic control of supramolecular peptide self-assembly, Nat Commun. 2016; 7: 13190.

## Research Description

My Bioinspired Materials Laboratory is a material science lab, focusing on mimicking self-assembly processes that occur in nature. Emphasizing organic chemistry and biomedical applications, we investigate processes such as biomineralization and the organization of short peptides and amino acids into ordered nanostructures. One of our central techniques is the formation of hybrid hydrogels, using two or more different building blocks to produce a 3D hydrogel with novel and diverse properties that can be easily fine-tuned. This has enabled us to develop new organic materials for various applications, such as 3D hydrogels for bone tissue regeneration, exhibiting extraordinary mechanical properties and durability, along with biocompatibility and controlled drug release. In addition, the laboratory is interested in antimicrobial activity of nanostructures, which may prove useful for coatings, and be incorporated into composite materials for applications in dental medicine.

# Dr. Roey J. Amir

**Affiliation:** Chemistry
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## Research Title

**Smart polymers**

## Selected Publications

1. Harnoy, A. J., Rosenbaum, I., Tirosh E., Ebenstein Y., Shaharabani R., Beck R., Amir, R. J., Enzyme-responsive amphiphilic PEG-dendron hybrids and their assembly into smart micellar nanocarriers, Journal of the American Chemical Society (2014), 136, 7531-7534.
2. Rosenbaum I., Harnoy A. J.; Tirosh E., Buzhor M., Segal M., Frid L., Shaharabani R., Avinery R., Beck R., Amir R. J., Encapsulation and covalent binding of molecular payload in enzymatically activated micellar nanocarriers, Journal of the American Chemical Society (2015), 137, 2276-2284.
3. Buzhor M., Harnoy A., Tirosh E., Barak A., Schwartz T., Amir R. J., Supramolecular translation of enzymatically triggered disassembly of micelles into tunable fluorescent responses, Chemistry - A European Journal (2015), 21, 15633–15638.
4. Amir R. J., Enzyme-responsive PEG-dendron hybrids as platform for smart nanocarriers, Synlett (2015), 26 (19), 2617-2622.
5. Buzhor M., Avram L., Frish L., Cohen Y., Amir R. J., Fluorinated smart micelles as enzyme-responsive probes for 19F-magnetic resonance, Journal of Materials Chemistry B (2016), Advance Article DOI: 10.1039/C5TB02445E.

## Research Description

Stimuli-responsive nanocarriers that can disassemble to release their encapsulated cargo upon external stimuli have gained increasing attention due to their possible utilization as smart drug delivery systems. Among the various types of stimuli, enzymes offer great potential for the activation of biomedical carriers, due to their overexpression in various diseases. The design of enzyme-responsive block copolymers is highly challenging, as the enzyme must reach the enzyme-sensitive moieties - which are spread along the backbone of the polymer, and might be hidden inside the hydrophobic cores of the self-assembled structures. The polydispersity of the stimuli-responsive block raises another significant challenge for the kinetic analysis and mechanistic study of the enzymatic response, as the enzyme's access to the enzymatically activated moieties can vary greatly - depending on their location along the polymer backbone, the length of the polymer chain, and its solubility. To address these challenges, we are developing highly modular polymeric platforms based on amphiphilic PEG-dendron hybrids. These amphiphilic hybrids can self-assemble in water into micellar nanocontainers that disassemble and release encapsulated molecular cargo upon enzymatic activation. The modularity of these PEG-dendron hybrids offers great control and tuning of the disassembly rate of the formed micelles, through simple adjustment of the PEG's length. Such smart amphiphilic hybrids could open the way for the fabrication of nanocarriers with tunable release rates for drug delivery applications.

# Prof. David Andelman

**Affiliation:** Physics
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## Research Title

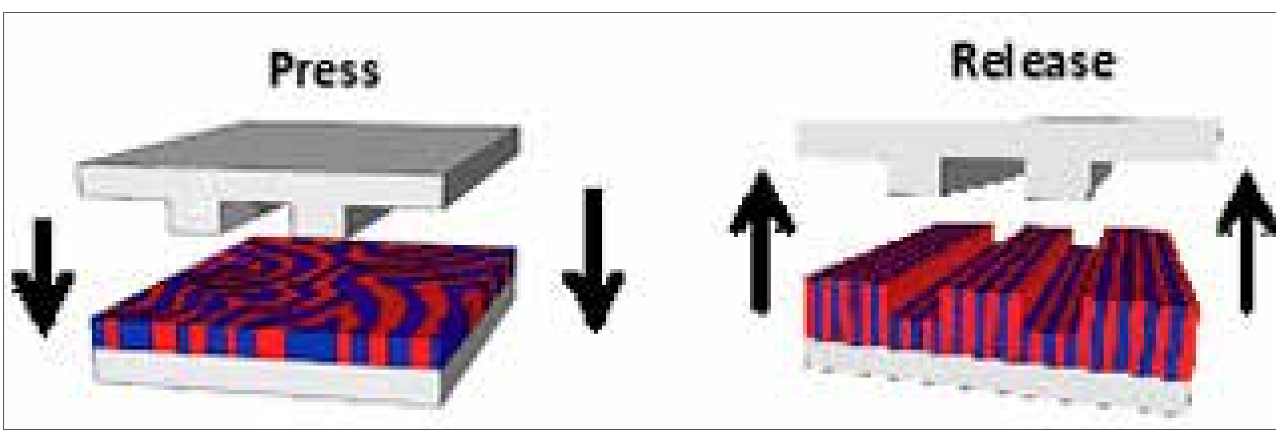
**Theoretical modeling of soft and biological matter**

## Selected Publications

1. Bjerrum pairs in ionic solutions: a Poisson-Boltzmann approach, R. M. Adar, T. Markovich, and D. Andelman, J. Chem. Phys. 146, 194904 (2017).
2. Defect-free perpendicular diblock copolymer films: the synergistic effect of surface topography and chemistry, X. Man, P. Zhou, J. Tang, D. Yan, and D. Andelman, Macromolecules 49, 8241-8248 (2016).
3. Ionic profiles close to dielectric discontinuities: specific ion-surface interactions, T. Markovich, D. Andelman, and H. Orland, J. Chem. Phys. 145, 134704.1-12 (2016).
4. Budding transition of asymmetric two-component lipid domains, J. Wolff, S. Komura, and D. Andelman, Phys. Rev. E 94, 032406.1-9 (2016).
5. Free energy approach to micellization and aggregation: equilibrium, metastability and kinetics, H. Diamant and D. Andelman, Curr. Opin. Colloid Interface Sci. 22, 94-98 (2016).

## Research Description

My group specializes in studying soft matter and biological systems, in collaboration with several experimental teams worldwide. In particular, we explore the properties of self-assembling polymers, and ways to manipulate them at patterned surfaces and in thin-film geometries, in relation with nano-lithography. In another line of research, we explore bio- and soft matter systems in which charges play an important role. We investigate ionic liquids at charge interfaces and membranes, and the response of ionic solutions and charged macromolecules to external electric fields.



# Prof. Ady Arie

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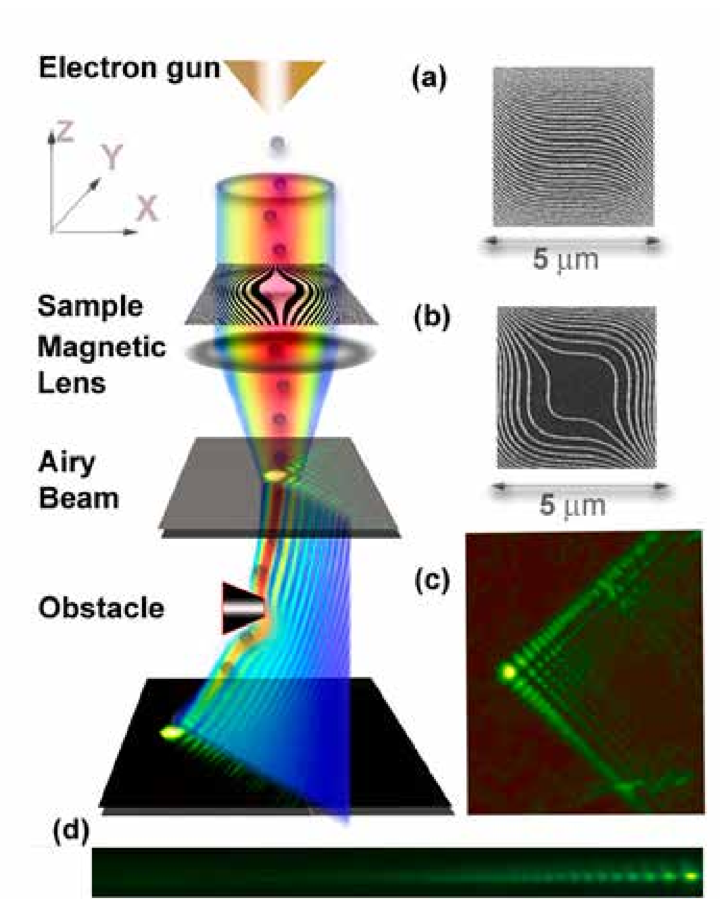
## Research Title

**Nonlinear optics, plasmonics, electron microscopy**

## Selected Publications

1. Voloch-Bloch N., Lereah Y., Lilach Y., Gover A. and Arie A. (2013). Generation of electron Airy beams, Nature 494, 331-335.
2. Suchowski H., Porat G. and Arie A. (2014). Adiabatic processes in frequency conversion, Lasers and Photonics Reviews 8, 333-367.
3. Epstein I. and Arie A. (2014). Arbitrary bending plasmonic light waves, Physical Review Letters 112, 023903.
4. Remez R. and Arie A. (2015). Super-narrow frequency conversion, Optica 2, 472-475.
5. Shapira A., Naor L. and Arie A., (2015). Nonlinear optical holograms for spatial and spectral shaping of light waves, Science Bulletin 60, 1403-1415.




## Research Description

Our group is active in several areas of research: nonlinear optics, plasmonics and electron beam shaping.

In nonlinear optics, we mainly concentrate on quadratic nonlinear processes in ferroelectric crystals. The ability to modulate the quadratic nonlinear coefficient is used for shaping the spatial and spectral response of the nonlinear crystal.

In plasmonics, our efforts in recent years have focused on generating special types of plasmonic beams. To this end, we have developed special types of couplers between free-space light beams and plasmonic beams, applying concepts and coding schemes developed in the field of holography.

In electron beam shaping, we utilize a recent technological breakthrough, enabling us to shape the phase and amplitude of electron beams by passing them through a thin SiN membrane, patterned by focused ion beam milling.

# Prof. Uri Ashery

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## Research Title

**Molecular mechanisms of synaptic transmission**

## Selected Publications

1. Bar-On D, Wolter S, van de Linde S, Heilemann M, Nudelman G, Nachliel E, Gutman M, Sauer M, Ashery U. (2012). Super-resolution imaging reveals the internal architecture of nano-sized syntaxin clusters. J Biol Chem. 2012 3;287(32):27158-67.
2. Bielopolski, N., Lam, A. D., Bar-On, D., Sauer, M., Stuenkel, E. L., and Ashery, U. (2014). Differential interaction of tomosyn with syntaxin and SNAP25 depends on domains in the WD40 beta-propeller core and determines its inhibitory activity. J Biol Chem 289, 17087-17099.
3. Ehmann, N., van de Linde, S., Alon, A., Ljaschenko, D., Keung, X. Z., Holm, T., Rings, A., DiAntonio, A., Hallermann, S., Ashery, U., Heckmann, M., Sauer, M., and Kittel, R. J. (2014). Quantitative super-resolution imaging of Bruchpilot distinguishes active zone states. Nat Commun 5, 4650.

## Research Description

Our laboratory investigates the functions of key synaptic proteins in synaptic transmission and plasticity, both in health and in neurodegenerative diseases. The lab applies a multidisciplinary approach, pooling expertise in molecular biology, electrophysiology, biochemistry, optogenetics, high-end imaging and computer-simulation techniques, to understand how neurons communicate at the cellular and molecular levels to influence animal behavior. Recently, we integrated a novel method, termed super-resolution microscopy, enabling the detection of protein distribution at single-molecule 20-nm resolution. Using several super-resolution methods (dSTORM, STED) and combining experimental and computational capabilities, our group described how the spatial distribution of synaptic proteins from the SNARE and active zone families influences synaptic transmission (J. Biol. Chem. 2012; J. Biol. Chem. 2014; Nat. Commun. 2014). We are now using this system to investigate how the alpha synuclein protein forms aggregates, and to discover the mode of action of specific inhibitors, such as chemical chaperones and aromatic small molecules. Work is performed on brain slices, induced pluripotent stem cells and cell lines.

# Prof. Karen B. Avraham

**Affiliation:** Medicine
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## Research Title

**Genomic analysis of hereditary hearing loss**

## Selected Publications

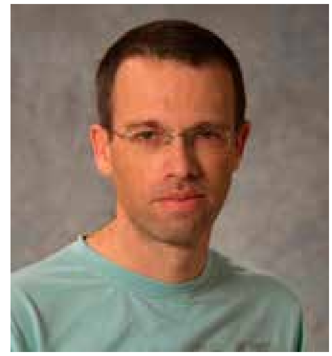
1. Perl, K., Ushakov, K., Pozniak, Y., Yizhar-Barnea, O., Bhonker, Y., Shivatzki, S., Geiger, T., Avraham, K.B.*, Shamir, R.* (2016) Reduced changes in protein compared to mRNA levels across non-proliferating tissues. BMC Genomics, 18:305.
2. Ushakov, K., Koffler-Brill, T., Rom, A., Perl, K., Ulitsky, I., Avraham, K.B. (2017) Genome-wide identification and expression profiling of long non-coding RNAs in auditory and vestibular systems. Sci. Rep., 7:8637.
3. Rudnicki, A.*, Isakov, O.*, Ushakov, K., Shivatzki, S., Weiss, I., Friedman, L.M., Shomron, N. and Avraham, K.B. (2014) Next-generation sequencing of small RNAs from inner ear sensory epithelium identifies microRNAs and defines regulatory pathways. BMC Ge
4. Rudnicki, A., Shivatzki, S., Beyer, L.A., Takada, Y., Raphael, Y. and Avraham, K.B. (2014) microRNA-224 regulates Pentraxin 3, a component of the humoral arm of innate immunity, in inner ear inflammation. Hum. Molec. Genet. 23:3138-46.
5. Brownstein, Z., Friedman, L.M., Shahin, H., Oron-Karni, V., Kol, N., Abu Rayyan, A., Parzefall, T., Lev, D., Shalev, S., Frydman, M., Davidov, B., Shohat, M., Rahile, M., Lieberman, S., Levy-Lahad, E., Lee, M., Shomron, N., King, M. C., Walsh, T., Kanaan, M., Avraham, K.B. (2013) Novel myosin mutations for hereditary hearing loss revealed by targeted genomic capture and massively parallel sequencing. Eur J Hum Genet., 22:768-75.

## Research Description

A major goal in auditory science is to understand how the cells of the inner ear develop to provide the exquisite precision of hearing. The organ of Corti, which houses the sensory cells of the inner ear, develops from sensory epithelium derived from ectoderm. Together with innervation of the sensory spiral ganglion cells, the auditory system collects sounds and transforms their mechanical forces into an electrical signal that functions throughout our lifetime. At a molecular level, the interactions of DNA, RNA and proteins of the auditory system orchestrate a remarkable feat that is summarized in our ability to hear.

The challenge in auditory science is to determine which and how a pathogenic variant in a gene or regulatory element can cause the entire hearing system to fail. Our group is asking the questions: (1) What are the genes that lead to hearing loss and how are they involved in normal function of the inner ear? (2) How does regulation of gene expression govern the pathways that determine inner ear function, and how do alterations in regulation, on a genetic and epigenetic level, contribute to the pathology of deafness?

# Dr. Alon Bahabad



**Affiliation:** Electrical Engineering
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### Research Title
**Physical optics**

### Selected Publications

1. Itai Hadas and Alon Bahabad, Macroscopic manipulation of high-harmonic-generation through bound-state coherent control, Physical Review Letters, 113, 253902 (2014).
2. Yaniv Eliezer and Alon Bahabad, Super-transmission: The delivery of superoscillations through the absorbing resonance of a dielectric medium, Optics Express, 22, 31212-31226 (2014).
3. Mor Konsens and Alon Bahabad, Time-to-frequency mapping of optical pulses using accelerating quasi-phase-matching, Physical Review A, 93, 023823 (2016).
4. Alon Bahabad, Margaret M. Murnane and Henry C. Kapteyn, Quasi phase matching of momentum and energy in nonlinear optical processes, Nature Photonics, 4, 570-575 (2010).
5. Ron Lifshitz, Ady Arie and Alon Bahabad, Photonic quasicrystals for general purposes nonlinear optical frequency conversion, Physical Review Letters, 95, Issue 13, 133901 (2005).

### Research Description

Our group is interested in theoretical and experimental research in various areas of physical optics. One of our major areas of research is the generation of coherent light sources at very high photon energies (soft X-rays). For this we employ the extreme nonlinear optical process of high-harmonic-generation (HHG). HHG is driven with an intense ultra-short light pulse which ionizes a gaseous medium. The liberated electron then oscillates in the laser field, gaining kinetic energy. There is a small chance that the electron will encounter the ion from which it has been liberated and recombine with it. The excessive kinetic energy gained by the electron is released in the form of a high energy photon. During such a process, hundreds of photons in the laser field can be converted into a single high-energy photon. We are interested in mediating this process by employing plasmon-assisted field enhancement. When the laser light interacts with a metallic nanostructure, electron oscillations on the metal surface can lead to a significant field enhancement. This can be utilized to assist with the process of HHG. In addition, the geometry of the metallic nanostructure can be used to control the beam shape and polarization state of the generated high harmonic radiation.

# Prof. Roy Beck

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## Research Title

**Experimental nanoscale biophysics**

## Selected Publications

1. R. Beck, J. Deek, J.B. Jones, C.R. Safinya, Gel expanded to gel condensed transition in neurofilament networks revealed by direct force measurements, Nature Materials 9, 40-46 (2010), PMID:19915555.
2. A. Laser-Azogui, M. Kornreich, E. Malka-Gibor, R. Beck, Neurofilament assembly and function during neuronal development. Current Opinion in Cell Biology 32, 92-101 (2015). DOI: 10.1016/j.ceb.2015.01.003.
3. G. Jacoby, K. Cohen, K. Barkan, Y. Talmon, D. Peer, R. Beck, Metastability in lipid based particles exhibits temporally deterministic and controllable behavior. Scientific Reports 5, 9481 (2015), DOI:10.1038/srep09481. PMID: 25820650.
4. R. Shaharabani, M. Ram-On, R. Avinery, R. Aharoni, R. Arnon, Y. Talmon, R. Beck, Structural transition in myelin membrane as initiator of Multiple Sclerosis, Journal of the American Chemical Society 138 (37), 12159–12165 (2016). DOI: 10.1021/jacs.6b04826.
5. M. Kornreich, E. Malka-Gibor, B. Zuker, A. Laser-Azogui, R. Beck, Neurofilaments function as shock absorbers: compression response arising from disordered proteins, Physical Review Letters 117, 148101 (2016). DOI: 10.1103/PhysRevLett.117.148101. arXiv:16.

## Research Description

In many significant biological functions the four basic building blocks (proteins, lipids, sugars and nucleic acids) aggregate to form supramolecular structures and assemblies. The forces and interactions responsible for these assemblies are composed of a set of interactions with energy scales ranging from thermal fluctuations (a few KT) to specific covalent bonds (100's of KT). Relevant length scales in biological systems span many orders of magnitude, from the single amino acid through polypeptide chains, protein complexes and organelles, all the way up to cells and organs. These different length scales present enormous challenges, both experimentally and theoretically.

In order to properly study biological systems and the interactions within them, it is important to have complementary techniques covering different length and energy scales, in proximity to their natural environment. In our laboratory we purify the subunit biological building blocks, using a variety of state-of-the-art biochemical and molecular techniques. We then reassemble them in precise conditions, to extract the underlying physics pertaining to their supramolecular forces, dynamics and steady-state structures, particularly as they appear in healthy and diseased states.

We use small- and wide-angle x-ray scattering (SAXS & WAXS) techniques to cover length scales from 0.1-100 nm. These techniques are suitable for measuring weak scattering from biological systems in their natural environment. Detailed analysis and advanced computational techniques are regularly used to convert the reciprocal space into real-space structures, and enable studies on the nature of the interactions within the biological assemblies. SAXS, in particular, provides a ready means for determining inter-filament spacing and interactions. Recent advances in solid-state type x-ray detectors and high-flux microfocus x-ray sources allow investigation of dynamic structural events, as well as highly penetrated measurements. Conveniently, these approaches do not require staining or other modifications, and thus do not perturb our system, allowing easier access to the supramolecular forces underlying self-assembly, and simplifying data analysis.

# Prof. Itai Benhar

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## Research Title

**Targeted nanomedicines**

## Selected Publications

1. Artzy-Schnirman A, Blat D, Talmon Y, Fishler R, Gertman D, Oren R, Wolchinsky R, Waks T, Benhar I, Eshhar Z, Sivan U, Reiter Y. (2011). Electrically controlled molecular recognition harnessed to activate a cellular response. Nano Lett. 11(11):4997-5001.
2. Vaks L, Benhar I. (2011). In vivo characteristics of targeted drug-carrying filamentous bacteriophage nanomedicines. J. Nanobiotech 9:58.
3. Saggy I, Wine Y, Shefet-Carasso L, Nahary L, Georgiou G, Benhar I (2012) Antibody isolation from immunized animals: comparison of phage display and antibody discovery via V gene repertoire.
4. Levi O, Tal B, Hileli S, Shapira A, Benhar I, Grabov P, Eliaz N (2016). Optimization of EGFR high positive cell isolation procedure by design of experiments methodology. Cytometry B Clin Cytom. 2015 Sep-Oct;88(5):338-47. doi: 10.1002/cyto.b.21246.
5. Halperin A, Shadkchan Y, Pisarevsky E, Szpilman AM, Sandovsky H, Osherov N, Benhar I (2016). Novel water-soluble Amphotericin B-PEG conjugates with low toxicity and potent in vivo efficacy. J Med Chem. 2016 Feb 11;59(3):1197-206.

## Research Description

For several years we have been developing targeted drug-carrying nanomedicines, based on a core technology of genetically and chemically engineered virus particles. We developed such guided missiles to treat devastating diseases, such as life-threatening infections caused by drug-resistant bacteria, and also for potential cancer therapy. Currently, we are focusing our efforts on developing treatments of this type for pathogenic fungi that cause life-threatening lung infections in cystic fibrosis and transplant patients. In this novel work, the drug carriers are none other than genetically and chemically engineered viruses.

For several years now we have been developing new techniques to genetically modify bacteriophages to carry drugs to specific locations in the body, in order to treat various diseases, such as cancer and fungal infections. This approach is based on genetically modifying and chemically manipulating the phages: the genetic manipulation endows the phages with the ability to display a host-specificity-conferring ligand (target-specific peptide, recombinant antibody or other target-specifying entity) on their surface. Chemically, the bacteriophages are conjugated through labile linkages that are subject to controlled cleavage to a drug. These targeted drug carrying phage nanoparticles have a large drug-carrying capacity in excess of ten thousand drug molecules per target site.

Previously, we evaluated the effectiveness of this approach for the elimination of pathogenic bacteria and for cancer therapy. In our current project, we develop such phages to treat recalcitrant fungal infections. The antibodies in this case are specific for binding with the pathogenic fungus – Aspergillus Fumigatus (AF) - that causes life-threatening lung infections in immunocompromised patients. The drug Amphotericin B is to be linked to the phages by means of chemical conjugation, through a genetically engineered labile linker, subject to controlled release as a result of proteolytic activity of the fungal protease Alp1.

At present we are working on conjugating the drug to the phages. To this end we synthesized PEG conjugates of Amphotericin B (AMB), to make the drug water soluble. In a recently published article we described the drug properties of these compounds as free drugs: they are still very potent as anti fungals, but very much reduced in non-specific toxicity.

Next we plan to complete the complicated task of conjugating the drug to the phages, and then test the efficiency of our drug delivery system in killing the fungus in culture and in a mouse lung infection model.

# Prof. David J. Bergman

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## Research Title

**Physical phenomena in composite media**

## Selected Publications

1. D. J. Bergman, Perfect imaging of a point charge in the quasistatic regime, Phys. Rev. A 89, 015801 (4 pp.) (2014).
2. D. J. Bergman and Y. M. Strelniker, Strong-field magneto-transport in a two-constituent columnar composite medium where the constituents have comparable resistivity tensors, Phys. Rev. B 86, 024414 (14 pp.) (2012).
3. M. Tornow, D. Weiss, K. von Klitzing, K. Eberl, D. J. Bergman, and Y. M. Strelniker, Anisotropic magnetoresistance of a classical antidot array, Phys. Rev. Lett. 77, 147{150 (1996).
4. D. J. Bergman and J. S. Ishay, Do bees and hornets use acoustic resonance in order to monitor and coordinate comb construction? Bulletin of Mathematical Biology 69(5), 1777, 1790 (2007).
5. D. J. Bergman and M. I. Stockman, Surface plasmon amplication by stimulated emission of radiation: Quantum generation of coherent surface plasmons in Nanosystems, Phys. Rev. Letters 90, 027402-1, 027402-4 (2003).

## Research Description

Research in our group focuses on the following:
1. Magneto-transport and magneto-optics in metal-dielectric composite media, when the Hall resistivity in the metallic constituent is greater than the Ohmic resistivity
2. Nano-plasmonics in such a medium
3. Macroscopic physical phenomena in social wasps: the exploitation of thermoelectric cooling to regulate the body temperature of the Oriental Hornet; the exploitation of ultrasonic acoustic resonances by worker hornets and worker bees in the construction of highly symmetric combs in a hornets' nest or beehive.

# Prof. Amir Boag

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## Research Title

**Rectifying nano-antennas**

## Selected Publications

1. Z. Iluz and A. Boag, Dual-Vivaldi wide band nano-antenna with high radiation efficiency over the infrared frequency band, Optics Letters, vol. 36, no 15, pp. 2773-2775, 2011.
2. E. Strassburg, A. Boag, Y. Rosenwaks, Reconstruction of Electrostatic Force Microscopy Images, Review of Scientific Instruments, vol.76, 083705, 28 July 2005.
3. Y. Yifat, Z. Iluz, D. Bar-Lev, M. Eitan, Y. Hanein, A. Boag, and J. Scheuer, High load-sensitivity in wideband infrared dual-Vivaldi nanoantennas, Optics Letters, vol. 38, no. 2, pp. 205–207, 2013.
4. Y. Yifat, M. Eitan, Z. Iluz, Y. Hanein, A. Boag, and J. Scheuer, Highly efficient and broadband wide-angle holography using patch-dipole nano-antenna reflectarrays, Nano Letters, March 19, 2014.
5. G. Y. Slepyan and A. Boag, Quantum non-reciprocity of nanoscale antenna arrays in timed Dicke states, Physical Review Letters, vol. 111, 023602, 11 July, 2013.

## Research Description

The dramatic increase in worldwide demand for electrical power makes it clear that the development of clean, renewable alternative energy sources is essential, with solar power harvesting as the leading direction. The basic properties of conventional photovoltaic solar cells are determined by their materials' chemistry and the corresponding electronic properties. As a result, such solar cells have inherent and fundamental limitations in terms of optical bandwidth, efficiency and cost. On the other hand, power harvesting utilizing RF approaches has demonstrated high efficiency (exceeding 85%) in the radio-frequency spectral range, as well as low fabrication costs. The objective of our research is to develop new detection and power conversion schemes for optical frequencies, based on metallic rectifying nano-antennas (rectennas). A nano-rectenna includes two fundamental elements: an antenna and a rectifier. The antenna receives the EM wave and converts it into an alternating electric current (AC). The rectifier converts the AC current into a direct current (DC). We have demonstrated the ability to design, optimize and fabricate ultra-wideband nano-antenna arrays. We have measured the spectral properties of the scattered field from these antennas, and shown very good agreement with numerical simulations. We have also demonstrated preliminary success in integrating the nano-antennas with the rectifiers. We now intend to utilize these abilities to develop a new concept for solar-power harvesting, which can revolutionize the field by providing an inexpensive and efficient approach for direct EM to DC power conversion.

# Prof. Chanoch Carmeli


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|---|---|
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## Research Title

**Nanotechnology of photosynthesis**

## Selected Publications


1. Carmeli, I; Kumar, KS; Heifler, O; Carmeli, C., Naaman, R. Spin selectivity in electron transfer in photosystem I. Agnew. Chem. Inter. Ed. 2014, 53, (34) 8953-8958 2014.
2. H. Toporik, I. Carmeli, I. Volotsenko, M.Molotskii, Y. Rosenwaks, C. Carmeli and N. Nelson, Large photovoltages generated by plant photosystem I prystals. Adv. Mater. 2012, 24, 2988–2991.
3. L. Sepunaru, I. Tsimberov, L. Forolov, C. Carmeli, I. Carmeli* and Y. Rosenwaks*, Picosecond electron transfer from photosysnthetic reaction center protein to GaAs Nano Lett. 2009, 9 (7) 2751-2755.
4. L. Frolov, Y. Rosenwaks, S. Richter, C. Carmeli and I. Carmeli, Photoelectric junctions between GaAs and photosynthetic reaction center protein, J. Phys. Chem. C. 2008, 112, 13426-13430.
5. L. Frolov, O. Wilner, C. Carmeli and I. Carmeli, Fabrication of oriented multilayers of photosystem I proteins on solid surfaces by auto-metallization, Adv. Mater. 2008, 20, 263–266.

* Equally contribution


## Research Description

The reaction center photosystem I (PSI) is a membrane protein-chlorophyll complex. PSI functions as a photodiode converting light quanta into electrical charges of 1V at a quantum efficiency of ~100%. We investigate the novel properties of hybrid PSI-metals - metal nanoparticles, semiconductors and nanotube devices, and study the interaction between PSI and the solids, and the efficiency of charge transfer through the fabricated electronic junctions.

Oriented monolayers and multilayers of PSI are self-assembled by forming a sulfide bond between metal surfaces and unique cysteine mutants of genetically modified PSI from cyanobacteria. The dry layers generate photo potential. Covalent junctions between the protein and the solid surface form efficient electronic junctions that mediate charge transfer at a ps time scale. Oriented multilayers are fabricated by autometalization, with cross linker molecules connecting the serial layers. When placed between metal and transparent electrodes, photovoltage and a photocurrent are generated. The oriented multilayers of PSI enhance the photovoltage and photocurrent, due to the serial arrangement of the dipoles and the enhanced absorption cross section. A surface photo potential of up to 100V was recorded in PSI crystals where hundreds of layers were serially oriented. Hybrids of carbon nanotubes and PSI are fabricated by activating the nanotubes and attaching the unique cysteine in the engineered protein through small bifunctional molecules. PSI that has cysteine on both the oxidizing and reducing ends of the protein forms junctions - either between nanotubes or between nanotubes and metal electrodes. The PSI in hybrid PSI-nanotube devices thus enhances the nonotubes' photo conductance by an order of magnitude.

# Prof. Ori Cheshnovsky

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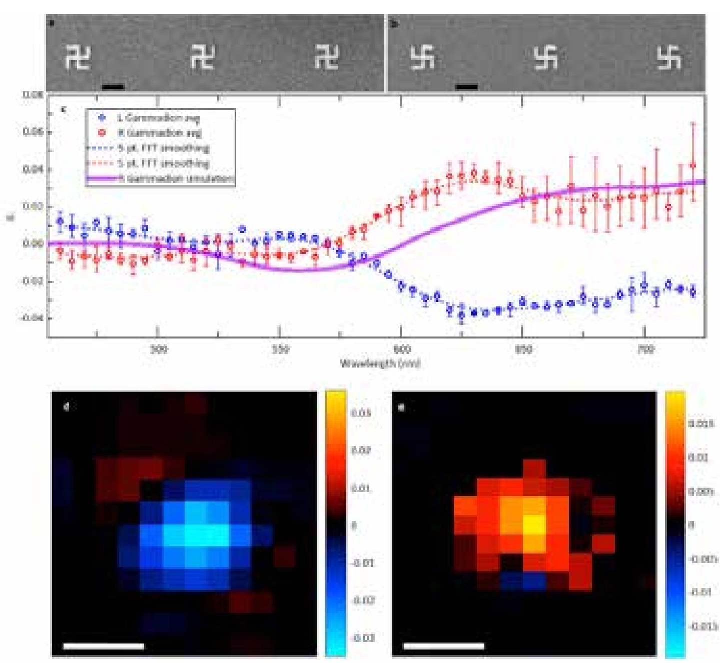
## Research Title

**Circular Dichroism of Individual Nanoparticles**

## Selected Publications

1. O. Tzang, A. Pevzner, R.E. Marvel, R.F. Haglund, O. Cheshnovsky (2015). Super-resolution in label-free photomodulated reflectivity, Nano Letters, 15, 1362.
2. O. Tzang, O. Cheshnovsky (2015). New modes in label-free super resolution based on photo-modulated reflectivity, Optics Express, 23, 20926.
3. T. Juffman, A. Milic, M. Mullneritsch, P. Asenbaum, A. Tsukernik, J. Tuxen, M. Mayor, O. Cheshnovsky, M. Arndt (2012). Real time single molecule imaging of quantum interference, Nature Nanotechnology, 7 296-299.
4. Z. Ioffe, T. Shamai, A. Ophir, G. Noy, I. Yutsis, K. Kfir, O. Cheshnovsky, Y. Selzer. (2008). Detection of heating in current carrying molecular junctions by Raman scattering, Nature Nanotechnology 3, 727.
5. E. Flaxer, O. Sneh and O. Cheshnovsky (1993). Molecular light emission induced by inelastic electron tunneling, Science 262, 2012-2014.



SEM micrographs of the left and right handed 550 nm wide gammadions. (c) Transmission dissymmetry spectra for 550 nm Gammadions. The dotted line is the average filtered by a low pass FFT filter while the solid purple line is the simulated spectra calculated using FDTD for a Gaussian beam (d, e) Left handed (at 650 nm wavelength) and right handed (at 600 nm wavelength) 550nm Gammadions spatial dissymmetry maps, (scale bar 500 nm).

## Research Description

In our laboratory we recently used a new kind of microscopy (used what??) to measure Circular Dichroism (CD) on individual nano-objects.

Being a weak phenomenon (typically a small fraction of absorption), CD is routinely measured on macroscopic quantities of matter in solutions, crystals or arrays of fabricated meta-particles. These ensemble-averaged measurements mask the sensitivity of CD to small structural variations between individual nano-objects or to the possible co-existence of opposite enantiomers in the ensemble. We have developed far field extinction microcopy, which enables sensitive CD measurement on individual nano-objects, encompassing dramatic suppression of linear optical activity artifacts. We report on CD of both chiral-shaped plasmonic nanostructures (gold Gammadions) and achiral-shaped inorganic nanocrystals having a chiral crystal lattice (HgS). CD spectra and spatial mapping were measured. Simulations on Gammadions, mimicking the experimental conditions, showed good correlation to the measurements. This work extends the single-particle-spectroscopy toolbox to include CD spectroscopy.

# Dr. Guy Cohen

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## Research Title

**Developing computational and theoretical methods for quantum many-body systems out of equilibrium**

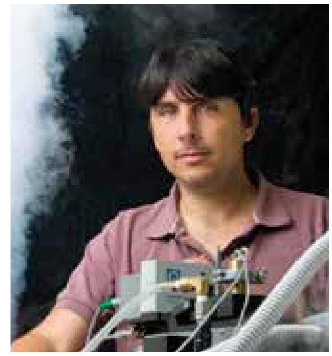
## Selected Publications

1. Q. Dong, I. Krivenko, J. Kleinhenz, A.E. Antipov, G. Cohen, E. Gull, Quantum Monte Carlo solution of the dynamical mean field equations in real time, Phys. Rev. B 96, 155126, (2017).
2. G. Cohen, E. Gull, D.R. Reichman, A.J. Millis, Taming the dynamical sign problem in real-time evolution of quantum many-body problems, Phys. Rev. Lett. 115, 266802, (2015).
3. H.T. Chen, G. Cohen, D.R. Reichman, Inchworm Monte Carlo for exact non-adiabatic dynamics I. Theory and algorithms, J. Chem. Phys. 146, 05410, (2017).
4. H.T. Chen, G. Cohen, A.J. Millis, D.R. Reichman, The Anderson–Holstein model in two flavors of the noncrossing approximation, Phys. Rev. B 93, 174309, (2016).
5. G. Cohen, E. Gull, D.R. Reichman, and A.J. Millis, Green's functions from real-time bold-line Monte Carlo calculations: spectral properties of the nonequilibrium Anderson impurity model, Phys. Rev. Lett. 112, 146802, (2014).

## Research Description

Our group investigates nonequilibrium phenomena in chemical and condensed matter physics. We try to understand how strongly correlated quantum systems react to dissipative environments and to external perturbations, particularly in the context of the transport properties of nanosystems. This is a deeply challenging and fundamental problem, and we therefore work to improve state-of-the-art computational methods, such as real-time quantum Monte Carlo algorithms. Our recently developed Inchworm Monte Carlo methods circumvent the dynamical sign problem - the primary bottleneck which prevented the application of previous-generation Monte Carlo methods to non-equilibrium systems and dynamics.

# Prof. Yoram Dagan



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## Research Title

**Emergent phenomena at surfaces and interfaces**

## Selected Publications

1. M. Ben Shalom, M. Sachs, D. Rakhmilevitch, A. Palevski and Y. Dagan, Tuning spin-orbit coupling and superconductivity at the SrTiO3/LaAlO3 interface: a magneto-transport study, Phys. Rev. Lett. 104, 126802 (2010).
2. A. Ron and Y. Dagan, One-dimensional quantum wire formed at the boundary between two insulating LaAlO3/SrTiO3 interfaces, Phys. Rev. Lett. 112, 136801 (2014).
3. E. Lahoud, E. Maniv, M. Shaviv, M. Naamneh, A. Ribak, S. Wiedmann, L. Petaccia, Z. Salman, K. B. Chashka, Y. Dagan, A. Kanigel, Evolution of the Fermi surface of doped topological insulator with carrier concentration, Phys. Rev. B 88, 195107 (2013).
4. Itai Carmeli et al. and Yoram Dagan, Tuning the critical temperature of cuprate superconductor films with self-assembled organic layers, Angewandte Chemie International Edition, 51, 7162 (2012).
5. E. Maniv, M. Ben Shalom, A. Ron, M. Goldstein, A. Palevski, and Y. Dagan, Strong correlations elucidate the electronic structure and phase-diagram of LaAlO3/SrTiO3 interface , Nature Communications 6, 8239 (2015).

## Research Description

Recent developments in thin-film fabrication techniques have enabled the deposition of newly designed and well controlled oxide interfaces. These interfaces can have properties which are significantly different from their constituent materials. Correlated electrons in oxide interfaces result in a variety of properties, such as metal-insulator transition, superconductivity and magnetism, and these phase transitions can be tuned by external stimuli such as electric and magnetic fields and pressure. The ability to tune the phase transitions makes these interfaces particularly interesting - both from the perspective of basic science, and as potential components for future electronic devices. Of particular interest are new interfaces that can be used in future applications, such as spin-controlled electronics (spintronics) and quantum computation. Other fascinating examples are interfaces where multiple orders may coexist, such as superconductivity coexisting with magnetism, which can result in an exotic symmetry of the superconducting order-parameter, and ferromagnetism coexisting with ferroelectricity. Interface design has been proven successful in enhancing macroscopic orders, e.g. superconductivity, ferroelectricity and combining orders. Our challenge is to master these interfaces, understand them and use them as a platform for observation of exotic physical phenomena, as well as for new applications.

# Prof. Haim Diamant

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## Research Title

**Theory of complex fluids**

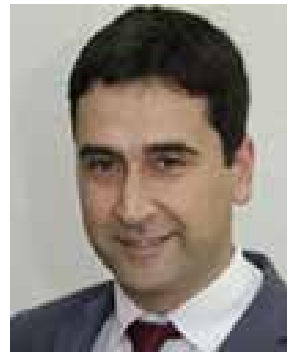
## Selected Publications

1. Diamant, H. (2015). Response of a polymer network to the motion of a rigid sphere. Eur. Phys. J. 38, 32.
2. Oshri, O., Brau, F., Diamant, H. (2015). Wrinkles and folds in a fluid-supported sheet of finite size. Phys. Rev. E 91, 052408.
3. Sonn-Segev, A., Blawzdziewicz, J., Wajnryb, E., Ekiel-Jezewska, M. L., Diamant, H., Roichman, Y. (2015). Structure and dynamics of a layer of sedimented Brownian particles. J. Chem. Phys. 143, 074704.
4. Oshri, O., Diamant, H. (2016). Properties of compressible elastica from relativistic analogy. Soft Matter 12, 664-668.
5. Goldfriend, T, Diamant, H., Witten, T. A. (2015). Hydrodynamic interactions between two forced objects of arbitrary shape: I Effect on alignment. Phys. Fluids 27, 123303.

## Research Description

Our research group attempts to understand the structure and dynamic response of soft materials and complex fluids using analytical models. Recent projects have included: instabilities in thin sheets, dynamics of driven colloidal suspensions, and correlations in confined fluids.

# Dr. Oswaldo Dieguez



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## Research Title

**Atomistic simulation of materials**

## Selected Publications

1. Epitaxial phases of BiMnO3 from first principles; O. Diéguez and J. Íñiguez: PHYSICAL REVIEW B 91, 184113 (2015).
2. Domain walls in a perovskite oxide with two primary structural order parameters: first-principles study of BiFeO3; O. Diéguez, P. Aguado-Puente, J. Junquera, and J. Iniguez: PHYSICAL REVIEW B 87, 024102 (2013).
3. First-principles investigation of morphotropic transitions and phase-change functional responses in BiFeO3-BiCoO3 multiferroic solid solutions; O. Diéguez, and J. Iniguez: PHYSICAL REVIEW LETTERS 107, 057601 (2011).
4. First-principles predictions of low-energy phases of multiferroic BiFeO3; O. Diéguez, O.E. Gonzalez-Vazquez, J. Wojdel, and J. Iniguez: PHYSICAL REVIEW B 83, 094105 (2011).
5. The SIESTA method; developments and applicability; E. Artacho, E. Anglada, O. Diéguez, J.D. Gale, A. Garcia, J. Junquera, R.M. Martin, P. Ordejon, M.A. Pruneda, D. Sanchez-Portal, and J. Soler: JOURNAL OF PHYSICS-CONDENSED MATTER 20, 064208 (2008).

## Research Description

At the Atomistic Simulation of Materials group we study materials by computationally solving the equations that their atoms follow. In this way we understand the properties of materials, perform virtual experiments under conditions that are hard to achieve in a real lab, and design new materials with tailored properties.

We focus on ferroelectrics - materials with technological applications in computer memories, sensors and actuators. We aim to advance the design of ferroelectrics by understanding their properties and improving them. Current topics of interest at our lab are ferroelectric domain walls and ferroelectrics that show magnetic ordering (multiferroics).

We also study other materials in collaboration with experimentalists. Over the last two years we carried out simulations in order to understand experiments in the growth of transition metal silicide nano-islands, learn about the structure of ReNi metallic alloys, and characterize the adsorption of polymers on metals in photovoltaic cells - to name several examples.

# Prof. Tal Dvir

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## Research Title

**Tissue engineering and regenerative medicine**

## Selected Publications

1. Feiner R, Engel L, Fleischer S, Malki M, Gal I, Shapira A, Shacham-Diamand Y, Dvir T. Engineered hybrid cardiac patches with multifunctional electronics for online monitoring and regulation of tissue function. Nature Materials. 2016 Mar 14. doi: 10.1038/nmat4590.
2. Baranes K, Shevach M, Shefi O, Dvir T. Gold nanoparticle-decorated scaffolds promote neuronal differentiation and maturation. Nano Letters 2015 Dec 19.
3. Fleischer S, Miller J, Hurowitz H, Shapira A, Dvir T. Effect of fiber diameter on the assembly of functional 3D cardiac patches. Nanotechnology. 2015 Jul 24;26(29):291002.

## Research Description

Our lab develops smart bio- and nanotechnologies for engineering complex tissues. Our work focuses on engineering cardiac patches for treating patients after heart attacks, and on developing cyborg tissues that integrate micro- and nanoelectronics with living organs to control their performance.

Our research interests include:

- Microfulidics-based tissue engineering - Recreating stem cell niches, microfluidic bioreactors for tissue engineering;
- Cardiac tissue engineering - Nanotechnological strategies for engineering thick cardiac tissue;
- Neural tissue engineering - Engineering a 3D neuronal network for spinal cord and brain regeneration;
- Integrating electronics with engineered tissues - Fabrication of nanoelectronics/engineered tissue hybrids;
- Smart delivery systems - Developing smart delivery systems that recruit stem cells to defective organs.

# Prof. Yuval Ebenstein

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## Research Title

**Single-molecule genomics**

## Selected Publications

1. Y. Michaeli, T. Shahal, D. Torchinsky, A. Grunwald, R. Hoch, and Y. Ebenstein, Optical detection of epigenetic marks: Sensitive quantification and direct imaging of individual hydroxymethylcytosine bases. Chem. Commun., (2013) 49 (77), 8599 - 8601
2. Y. Ebenstein, M. Levy-Sakin, Beyond Sequencing: Optical mapping of DNA in the age of nanotechnology and nanoscopy. Current Opinion in Biotechnology (2013) 24, (4), 690-698.
3. Y. Ebenstein, Weiss, S., Levy-Sakin M., Grunwald A., Kim, S., Gottfried, A., Lin, R.R., Dertinger, T., Kim, A.S., Chung, S., Colyer, R.A., Weinhold, E., Towards single-molecule optical mapping of the epigenome. ACS Nano, (2014) 8, (1), 14-26.
4. Y. Ebenstein, Jeremy Don, Shahar Zirkin, Sivan Fishman, Hila Sharim, Yael Michaeli, Lighting up individual DNA damage sites by in vitro repair synthesis. JACS (2014), 136, (21), 7771–7776.
5. T.F. Zhu, Y. Ebenstein, C. Lou, W. Jiang, X. Zhao, T. Gabrieli, Cas9-Assisted Targeting of CHromosome segments (CATCH) enables one-step targeted cloning of large gene clusters. Nat.Comm., (2015).

## Research Description

Our lab specializes in many areas of optical imaging and spectroscopy, with emphasis on single-molecule detection and the development of imaging-based techniques. Our research focuses on the application of novel imaging and optical detection approaches to genomic studies and biomarker detection. We develop new spectroscopy and microscopy methodologies that combine advanced optics with tools and reagents from the realm of nanotechnology. In addition, we have great interest in developing unique biochemistries for genomic analysis, based on chemo-enzymatic reactions.

# Prof. Eli Eisenberg

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## Research Title

**RNA editing**

## Selected Publications

1. N. Liscovitch-Brauer, S. Alon, H.T. Porath, B. Elstein, R. Unger, T. Ziv, A. Admon, E.Y. Levanon, J.J.C. Rosenthal and E. Eisenberg,Trade-off between transcriptome plasticity and genome evolution in cephalopods, Cell 169, 191–202 (2017).
2. Paz-Yaacov, L. Bazak, H.T. Porath, I. Buchumenski, M. Danan-Gotthold, B.A. Knisbacher, E. Eisenberg and E.Y. Levanon, Elevated RNA editing activity is a major contributor to transcriptomic diversity in tumors, Cell Reports 13, 267-276 (2015).
3. L. Bazak, A. Haviv, M. Barak, J. Jacob-Hirsch, P. Deng, R. Zhang, F.J. Isaacs, G. Rechavi, J.B. Li, E. Eisenberg and E.Y. Levanon, A-to-I RNA editing occurs at over a hundred million genomic sites, located in a majority of human genes, Genome Research 24, 365-376 (2014).
4. E. Eisenberg and E.Y. Levanon, Human housekeeping genes, revisited, Trends in Genetics, 29, 569-574 (2013).
5. S. Alon, E. Mor, F. Vigneault, G. Church, F. Locatelli, F. Galeano, A. Gallo, N. Shomron and E. Eisenberg, Systematic identification of edited microRNAs in the human brain Genome Research, 22, 1533-1540 (2012).

## Research Description

RNA modifications play an important role in regulating gene expression. A-to-I RNA editing is unique among these modifications, because it not only alters the fate of RNA molecules, but also 'recodes' the genetic information they contain. Recent studies have identified multiple conserved recoding sites that are under positive selection, and have functional and evolutionary importance. However, systematic mapping of the editome across the animal kingdom has also revealed that most editing sites are located in non-coding mobile elements, and these sites are thought to play a critical role in protecting against activation of innate immunity by self-transcripts. In our lab we use computational techniques to study various aspects of this phenomenon. Our work includes the development of methods for detection and quantification of editing, analysis of the genomic determinants affecting editing, and their evolution.

# Dr. Johann Elbaz

**Affiliation:** Life Sciences
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## Research Title

**Synthetic Biology toward living nanomaterials**

## Selected Publications

1. Elbaz J., Peng Y., Voigt C. A. Genetic encoding of DNA nanostructures and their self-assembly in living bacteria. Nature Comm. 7, 2016, 11179 doi: 10.1038/ncomms11179.
2. Elbaz J., Cecconello A., Fan Z., Govorov A.O., Willner I. Powering the programmed nanostructure and function of gold nanoparticles with catenated DNA machines. Nature Comm. 4, 2013, 2000. DOI: 10.1038/ncomms3000.
3. Elbaz J., Lioubashevski O., Wang F., Remacle F., Levine R.D., Willner I. DNA computing circuits using libraries of DNAzyme subunits. Nature Nanotechnology 5, 2010, 417-422.
4. Elbaz J., Moshe M., Willner I. Coherent activation of DNA tweezers: a "SET-RESET Logic System". Angew.Chem.Int.ed 48, 2009, 3834-3837.
5. Wang ZG*, Elbaz J.,* Remacle F., Levine R.D., Willner I. All-DNA finite-state automata with finite memory. Proc. Natl. Acad. Sci. U.S.A. 107, 2010, 21996-22001.

* Equally contribution

## Research Description

My lab conducts highly interdisciplinary research at the interface of biology, chemistry and material science, with applications for synthetic biology, nanotechnology and biotechnology.

Cells are most sophisticated mechanisms, selectively and simultaneously producing hundreds of thousands of complex molecules. Our group develops and applies new synthetic molecular biology pathways for the bio-production of "living molecules" in bacteria. These molecules may exhibit intriguing functions with diverse in-vivo applications, from medicine to energy, or offer a production route for new classes of materials with interesting physical capabilities (optical, electronic or as catalysts).

In this context, my lab currently focuses on developing synthetic biological tools for the expression of oligonucleotides and their self-assemblies in DNA nanostructures in bacteria. Defined DNA nanostructures inside living cells are investigated in order to confine and enhance specific chemical reactions for metabolic engineering, or to study the effects of spatial localization on multi-component biomolecular pathways.

# Dr. Avigdor Eldar

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## Research Title

**Elucidating bacterial communication systems**

## Selected Publications

1. Avigdor Eldar (2011). Social conflict drives the evolutionary divergence of quorum sensing. Partial penetrance facilitates developmental evolution in bacteria, Proceedings of the National Academy of Science, 108 (33): 13635-13640.
2. Avigdor Eldar,Vasant K. Chary, Panos Xenopoulos, Michelle E. Fontes,Oliver C. Losón, Jonathan Dworkin, Patrick J. Piggot PJ, Michael B. Elowitz. (2009). Self-enhanced ligand degradation underlies robustness of morphogen gradients, Nature, 460(7254):510-4.
3. Avigdor Eldar, Dalia Rosin, Ben-Zion Shilo and Naama Barkai. (2003). Robustness of the BMP morphogen gradient in Drosophila embryonic patterning, Developmental Cell, Vol 5, 635-646.
4. Avigdor Eldar, Ruslan Dorfman, Daniel Weiss, Hilary Ashe, Ben-Zion Shilo and Naama Barkai. (2002). Functional roles for noise in genetic circuits. Nature 419, 304-308.
5. Avigdor Eldar and Michael Elowitz. (2010). Functional Roles for Noise in Genetic Circuits. Avigdor Eldar and Michael Elowitz (Review), Nature, 467(7312):167-173.

## Research Description

Our main interest is in understanding the design principles of cooperative behavior in bacteria. More specifically, we focus on how bacterial communication (also known as quorum sensing) is involved in the regulation of cooperation. Our aim is to elucidate the impact of social structure, spatial form and phenotypic heterogeneity on the development of cooperation and its evolution. In order to study the phenomenon of cooperation in simple and complex structures we combine tools from microbiology, genetics, molecular biology, microscopy and quantitative modeling. Our main model organisms are the gram-positive soil bacteria B. subtilis and the gram-negative pathogen P. aeruginosa. These two organisms are major model systems of quorum sensing and biofilm development, allowing us to use their superb genetic tools and vast knowledge base as a starting point for our investigation.

# Prof. Noam Eliaz

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## Research Title

**From corrosion in space to degradation in vivo and functionality of implants**

## Selected Publications

1. N. Metoki, L. Liu, E. Beilis, N. Eliaz and D. Mandler. (2014) Preparation and characterization of alkylphosphonic acid self-assembled monolayers on titanium alloy by chemisorption and electrochemical deposition. Langmuir, 30(23), 6791-6799.
2. H. Zanin, C. Rosa, N. Eliaz, P. May, F. Marciano and A. Lobo. (2015) Assisted deposition of nano-hydroxyapatite onto exfoliated carbon nanotube oxide scaffolds. Nanoscale, 7, 10218-10232.
3. O. Levi, A. Shapira, B. Tal, I. Benhar and N. Eliaz. (2015) Isolating epideral growth factor receptor overexpressing carcinoma cells from human whole blood by Bio-Ferrography. Cytometry: Part B – Clinical Cytometry, 88, 136-144.
4. O. Levi, B. Tal, S. Hileli, A. Shapira, I. Benhar, P. Grabov and N. Eliaz. (2015) Optimization of EGFR high positive cell isolation procedure by Design of Experiments methodology. Cytometry: Part B – Clinical Cytometry, 88, 338-347.
5. T. Nusbaum, B.A. Rosen, E. Gileadi and N. Eliaz. (2015) Effect of pulse on-time and peak current density on pulse plated Re-Ni alloys. J. Electrochem. Soc., 162(7), D250-D255.

## Research Description

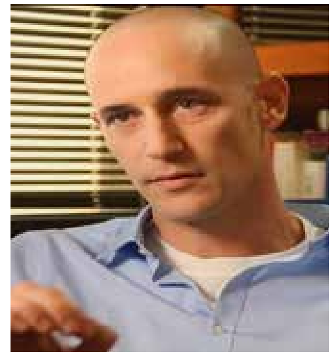
The Biomaterials & Corrosion Laboratory at Tel Aviv University strives to meet the demands of modern society by developing and studying advanced materials for a variety of applications - in biomedicine, space, harsh environments and other areas. Following are some of the lab's internationally renowned achievements:

1) The development of a novel electrochemically-deposited hydroxyapatite and other calcium phosphate coatings for orthopedic and dental implants. Our current generation of coatings is on its way to commercial use via collaboration with a manufacturer of dental implants, and we are now working on future generations. These will incorporate biological matter and drugs to reduce infections, increase osseointegration, and improve mechanical properties. In addition, self-assembled monolayers applied to the titanium substrate will enhance the strength of adhesion.

2) Electroplating and electroless plating of rhenium-based alloys. These projects, conducted in collaboration with Prof. Eliezer Gileadi from the TAU School of Chemistry, and funded by the US AFOSR and Israel's DoD, are intended mainly for aerospace, aircraft, and catalysis applications. Prof. Eliaz has studied the structure of such deposits at the atomic scale, using atom probe tomography (APT) and aberration-corrected transmission electron microscopy.

3) The magnetic isolation of biological matter for purposes of diagnosing diseases (such as cancer and osteoarthritis), determining the efficacy of drug treatment, and monitoring the wear of artificial joints - either at the design stage or during service in vivo. Ours is the only lab outside the US to have this capability, which is based on Bio-Ferrography.

# Prof. Tal Ellenbogen



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## Research Title

**Nanoscale light-matter interaction**

## Selected Publications

1. N. Segal, S. Keren-Zur, N. Hendler, T. Ellenbogen, Controlling light with metamaterial-based nonlinear photonic crystals, Nature Photonics 9, 180-184(2015).
2. E. Eizner, O. Avayu, R. Ditcovski, T. Ellenbogen, Aluminum nanoantenna complexes for strong coupling between excitons and localized surface plasmons, Nano Letters 15, 6215-6221(2015).
3. O. Avayu, O. Eisenbach, R. Ditcovski and T. Ellenbogen, Optical metasurfaces for polarization controlled beam shaping, Optics Letters 39, 3892-3895 (2014).
4. M. Rey, R. Elnathan, R. Ditcovski, K. Geisel, M. Zanini, M. A. Fernandez-Rodriguez, V. Naik, A. Frutiger, W. Richtering, T. Ellenbogen, N. H. Voelcker, L. Isa, Fully tunable silicon nanowire arrays by soft nanoparticle templating, Nano Lett. 2016 Jan 13;16(1):157-63.
5. Shay Keren-Zur, Ori Avayu, Lior Michaeli, and Tal Ellenbogen, Nonlinear beam shaping with plasmonic metasurfaces, ACS Photonics 3, 117-123 (2016).

## Research Description

We study the fundamentals of the interaction between light and matter at the nanoscale, in order to gain a better understanding of the underlying physical mechanisms of this interaction, and use it to develop the next generation of optical and electro-optical devices.

Our research involves: extensive fabrication and design of novel nanostructured materials for optical and electro-optical applications; characterization of the interaction of these materials with laser beams and incoherent light; and the development of relevant analytical or numerical models and simulations.

The lab's active lines of research and development currently include: stimulated emission effects in nano-complexes; emission control and synchronization for optical computing and lab-on-a-chip applications; nonlinear plasmonic metamaterials for optical wave mixing applications; hybrid light-matter excitations based on strongly coupled exciton-plasmon-polaritons and waveguide-exciton-polaritons as means for developing all-optical and electro-optical switches, coherent light sources and optical amplifiers; optical elements based on metamaterials and nano-antennas for consumer electronics and imaging devices; and new structured surfaces for interferometric microscopy.

# Dr. Sharly Fleischer

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## Research Title

**Ultrafast terahertz and optical coherent control of molecules**

## Selected Publications

1. Kallush, S., and Fleischer, S. (2015). Orientation dynamics of asymmetric rotors using random phase wave functions, Phys. Rev. A 91, 063420.
2. Fleischer, S., Field, R.W, and Nelson, K. (2014), From populations to coherences and back again – a new insight about rotating dipoles, arXiv:1405.7025. Bioinformatics. Nov 29. pii: btu797.
3. Fleischer, S., Field, R.W, and Nelson, K. (2012). Commensurate two quantum coherences induced by time delayed THz fields, Phys. Rev. Lett. 109, 123603.
4. Fleischer, S., Zhou, Y., Field, R.W, and Nelson, K. (2011). Molecular orientation and alignment by intense single-cycle THz pulses, Phys. Rev. Lett. 107, 163603.
5. Fleischer, S., Averbukh, I.Sh., and Prior, Y., (2007). Selective alignment of molecular spin isomers, Phys. Rev. Lett. 99, 093002.

## Research Description

Just as light is affected by the matter it interacts with in traditional spectroscopy, the state of matter can also be altered by light, and coherently driven to yield a desired goal. This field of research is known as 'coherent control'. Interested in both these mutually complementary processes, we use intense femtosecond light fields in both the terahertz range (THz fields, 10^12 Hz) and the visible/near-IR range (optical fields, 10^15 Hz) to coherently control and spectroscopically study the dynamics of molecules.

We develop new control schemes based on combined excitation by THz and optical fields, acting as two distinct molecular handles. We utilize these fields to induce unique angular distributions in molecular ensembles, and then study them via advanced ultrafast spectroscopic methods. With the help of intense light fields, we wish to control and study molecules of increasing size and complexity, and ultimately apply these methods to big molecules and nanostructures of chemical and biological interest.

# Prof. Ehud Gazit

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## Research Title

**Molecular self-assembly of biological, bio-inspired and other organic building blocks**

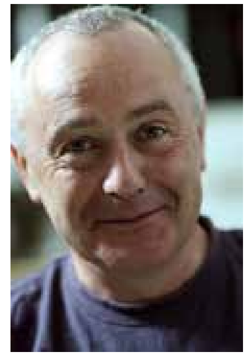
## Selected Publications

1. Fichman G., Guterman T., Damron J., Adler-Abramovich L., Schmidt J., Kesselman E., Shimon L.J., Ramamoorthy A., Talmon Y., Gazit E. (2016). Spontaneous structural transition and crystal formation in minimal supramolecular polymer model. Science Adv. 2, e1500827.
2. Berger O., Adler-Abramovich L., Levy-Sakin M., Grunwald A., Liebes-Peer Y., Bachar M., Buzhansky L., Mossou E., Forsyth V.T., Schwartz T., Ebenstein Y., Frolow F., Shimon L.J.W., Patolsky F., Gazit E. (2015). Light-emitting self-assembled peptide nucleic acids exhibit both stacking interactions and Watson-Crick base pairing. Nature Nanotech. 10, 353-360.
3. Mondal S., Adler-Abramovich L., Lampel A., Bram Y., Lipstman S., Gazit E. (2015). Formation of functional super-helical assemblies by constrained single heptad repeat. Nature Commun. 6, 8615.
4. Levin A., Mason T.O., Adler-Abramovich L., Buell A.K., Meisl G., Galvagnion C., Bram Y., Stratford S.A., Dobson C.M., Knowles T.P.J., Gazit E. (2014). Ostwald's rule of stages governs structural transitions and morphology of dipeptide supramole.
5. Adler-Abramovich L., Vaks L., Carny O., Trudler D., Magno A., Caflisch A., Frenkel D., Gazit E. (2012). Phenylalanine assembly into toxic fibrils suggests amyloid etiology In phenylketonuria. Nature Chem. Biol. 8, 701-706.

## Research Description

The work in our group focuses on the molecular self-assembly of biological, bio-inspired and other organic building blocks, a key process in chemistry and biochemistry. We apply a minimalistic approach to define the smallest molecular recognition and assembly modules, and understand the physicochemical basis for their association. We study the organization of biological systems in diverse fields, including amyloid diseases such as Alzheimer's disease and Parkinson's disease, diabetes, viral diseases and metabolic disorders. We have identified the ability of very short peptides, as well as metabolites, to form typical amyloidal nano-fibrils. Our study of minimal recognition modules has led to the discovery of a family of dipeptide nanostructures of various architectures, including nanotubes, nanospheres, nanoplates and hydrogel, with nanoscale order and unique mechanical, optical, piezoelectric and semiconductive properties. These various assemblies form from remarkably simple building blocks that can potentially be synthesized in large quantities at a low cost. We demonstrated how these peptide nanostructures can be used as casting molds for the fabrication of metallic nano-wires and coaxial nanocables. We used inkjet technology as well as vapor deposition methods to coat surfaces and form peptide 'nano-forests' in a highly controlled manner. We are currently employing microfluidic techniques to enable the formation of assembled products with specific size distribution, while controlling the assembly kinetics. We recently extended our studies to peptide nucleic acids (PNA), thereby converging the fields of peptide nanotechnology and DNA nanotechnology.

# Prof. Alexander Gerber



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## Research Title

**Hall effect spintronics**

## Selected Publications

1. Milner A., Gerber A., Karpovsky M. and Gladkikh A. (1996). Spin - Dependent electronic transport in granular ferromagnets. Phys. Rev. Lett. 76, 475 - 478.
2. Gerber A. (2007). Towards Hall Effect Spintronics. Jour. Magn. Matt., 310, 2749.
3. Segal A., Gerber A. and Karpovski M. (2011). Sixteen-states magnetic memory based on the extraordinary Hall effect. J. Magn.Magn.Matt. 324, 1557.
4. Simons A., Gerber A., Korenblit I.Ya., Suslov A., Raquet B., Passacantando M., Ottaviano L., Impellizzeri G., Aronzon B. (2014). Components of strong magnetoresistance in Mn implanted Ge. J. Appl. Phys. 115, 093703.
5. Winer G., Segal A., Karpovski M., Shelukhin V., and Gerber A. (2015). Probing Co/Pd interfacial alloying by the extraordinary Hall effect. J. Appl. Phys. 118, 173901.

## Research Description

Spintronics is an emerging field of basic and applied research in physics and engineering, in which the electron's magnetic degree of freedom - its spin - may be exploited for classical and quantum information processing. Carrying information in both the charge and spin of an electron potentially enables devices with greater functional diversity.

Our research focuses mainly on the spin-dependent Hall effect in a variety of artificial nanoscale materials, and on its application in a new generation of magnetic sensors, magnetic random access memories and logic devices.

# Dr. Alexander Golberg

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## Research Title

**Bioengineering for sustainability and health**

## Selected Publications

1. Towards marine biorefineries: Selective protein extractions from marine macroalgae Ulva with pulsed electric fields. Polikovsky M., Fernand F., Sack M., Frey W., Müller G., Golberg A. Innovative Food Science & Emerging Technologies. 2016.
2. Global potential of offshore and shallow water macroalgal biorefineries to provide food, chemicals and energy: feasibility and sustainability, Lehahn Y., Ingle K.N., Golberg A. Algal Research. 2016.
3. Long-term Listeria monocytogenes proliferation control in milk by intermittently delivered pulsed electric fields, implications for food security in the low-income countries. Golberg, A. Technology. 3(1):1-6, 2015.
4. Cloud-enabled microscopy and droplet microfluidic platform for specific detection of Escherichia coli in water. Golberg A., Linshiz G., Kravets I., Stawski N., Hillson N., Yarmush M.L., Marks, R.S., Konry T. Equal contributions. PLoS ONE 9(1): e86341.20.14.
5. Nanolayered siRNA delivery platforms for local silencing of CTGF reduce cutaneous scar contraction in third-degree burns, Castleberry S.A., Golberg A., Abu Sharkh M., Khan S., Almquist B.D., Austen W.G. Jr., Yarmush M.L., Hammond, P.T. Biomaterials. 2016. 14;95:2.

## Research Description

Global population growth and a rising quality of life in the era of climate change are expected to increase the demand for food, chemicals and fuels. A possible, sustainable direction for addressing this challenge is the production of biomass and the conversion of this biomass into the required products through a complex system known as a biorefinery. However, concerns over net energy balance, potable water use and environmental hazards, and uncertainty with regard to processing technologies — mostly problems with lignin—raise questions regarding the actual potential of terrestrial biomass to meet the anticipated food, feed and energy challenges in a sustainable way.

An alternative source of biomass for biorefineries is offshore-grown macroalgae. Macroalgae have been harvested throughout the world for centuries, both as a food source and as a commodity for the production of hydrocolloids. However, to date, macroalgae still represent only a tiny percentage of the global biomass supply: ~17·10E6 tons fresh weight (FW) of macroalgae compared to 16·10E11 tons of terrestrial crops, grasses and forests. A presently expanding body of evidence suggests that offshore-cultivated macroalgae, which contain very little lignin, and do not compete with food crops for arable land or potable water, can provide an alternative source of biomass for the sustainable production of food, chemicals, and fuels.

The goal of our laboratory is to develop a fundamental understanding of energy flows in offshore marine biorefineries, to boost the net energy return on investment, and to develop new technologies at the nano, micro and macro levels for implementing marine biorefineries for the benefit of humanity and society. To this end we are currently developing: 1) a climate simulator in silica; 2) technologies for algae breeding from 'spore to sea'; 3) microdevices for studying seaweed-bacteria interactions; 4) a portfolio of computational and experimental tools for biomass deconstruction and fermentation.

# Prof. Amir Goldbourt

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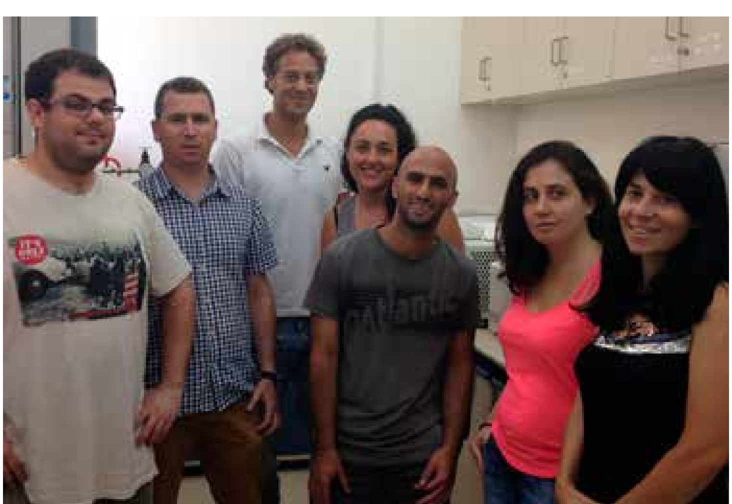
## Research Title

**Development and applications of magic-angle spinning NMR techniques for structural chemistry, biology and virology**

## Selected Publications

1. O. Morag, N. G. Sgourakis, D. Baker, A. Goldbourt, (2015). The NMR/Rosetta capsid model of M13 bacteriophage reveals a quadrupled hydrophobic packing epitope. PNAS 112(4), 971-976.
2. O. Morag, G. Abramov, and A. Goldbourt (2014). Complete chemical shift assignment of the ssDNA in the filamentous bacteriophage fd report on its conformation and on its interface with the capsid shell. J. Am. Chem. Soc. 136, 2292-2301.
3. E. Nimerovsky, R. Gupta, J. Yehl, M. Li, T. Polenova, A. Goldbourt (2014). Phase-modulated LA-REDOR: A robust, accurate and efficient solid-state NMR technique for distance measurements between a spin-1/2 and a quadrupole spin. J. Magn. Reson. 244, 107-11.
4. A. Haimovich, U. Eliav and A. Goldbourt (2012). Determination of the lithium binding site in inositol monophosphatase, the putative target for lithium therapy, by magic-angle spinning solid state NMR. J. Am. Chem. Soc. 134, 5647-5651.
5. G. Abramov, R. Shaharabani, O. Morag, R. Avinery, A. Haimovich, I. Oz, R. Beck*, A. Goldbourt* (2017). Structural effects of single mutations in a filamentous viral capsid across multiple length scales. Biomacromolecules 18, 2258-2266.

* Equally contribution



## Research Description

Research in our group focuses on developing and applying magic-angle spinning solid state NMR for the study of complex systems, with a particular emphasis on structural virology.

One example is the family of filamentous bacteriophages - bacteria-infecting viruses that share a similar virion structure and life cycle. The virion is composed of a circular ssDNA wrapped by thousands of similar copies of a major coat protein, with several different minor coat proteins at both ends. Our group prepares, purifies and uses magic-angle spinning NMR techniques to characterize the structure of various phages in atomic-detailed resolution.

Another area of interest is the NMR of metal ions, which play a crucial role in the function of enzymes. Low occupancies, dynamics and other obstacles often hinder the detailed characterization of such sites, and our group addresses this challenge. We develop and apply techniques for characterizing the structural environment of metal ions such as $^{11}B$, $^{51}V$, $^{7}Li$, $^{23}Na$ and other similar nuclei exhibiting a large anisotropic interaction in the magnetic field.

For example: lithium salts have been known as mood stabilizing drugs for bipolar disorder patients for over 50 years. It was hypothesized that lithium exerts its therapeutic effect by binding with the enzyme myo-inositol monophosphatase (IMPase), thereby reducing inositol levels in the blood and diminishing the hyperactive phosphatidyl-inositol cell signaling pathway. Other targets of lithium have also been proposed. Since lithium is mostly spectroscopically silent, we use magic-angle spinning NMR techniques to directly observe and characterize lithium's binding sites in its drug targets.

# Dr. Moshe Goldstein

**Affiliation:** Physics
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## Research Title

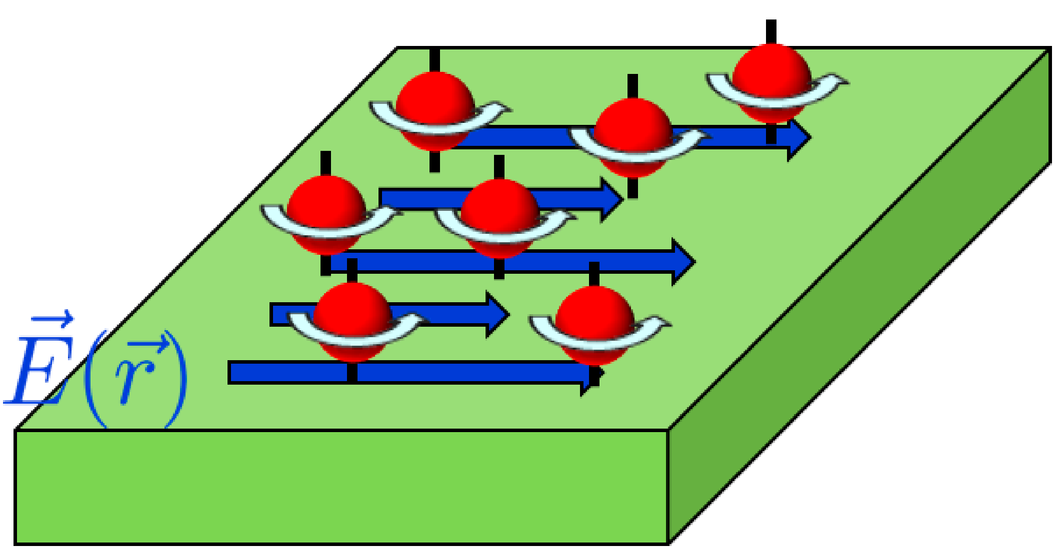
**Low-dimensional quantum condensed matter physics**

## Selected Publications

1. Moshe Goldstein and Richard Berkovits, Duality between different geometries of a resonant level in a Luttinger liquid, Phys. Rev. Lett. 104, 106403 (2010).
2. Moshe Goldstein, Richard Berkovits, and Yuval Gefen, Population switching and charge sensing in quantum dots: A case for a quantum phase transition, Phys. Rev. Lett. 104, 226805 (2010).
3. Barry Bradlyn, Moshe Goldstein, and Nicholas Read, Kubo formulas for viscosity: Hall viscosity, Ward identities, and the relation with conductivity, Phys. Rev. B 86, 245309 (2012).
4. Jukka I. Väyrynen, Moshe Goldstein, and Leonid I. Glazman, Helical edge resistance introduced by charge puddles, Phys. Rev. Lett. 110, 216402 (2013).
5. Eran Maniv, Moshe Ben Shalom, Alon Ron, Michael Mograbi, Alexander Palevski, Moshe Goldstein, and Yoram Dagan, Strong correlations elucidate the electronic structure and phase-diagram of LaAlO3/SrTiO3 interface, Nature Comm. 6, 8239 (2015).

## Research Description

My research concerns the theory (both analytical and numerical) of nanoscale and low-dimensional quantum condensed matter systems, including: semiconductors, normal and superconducting metals, carbon-based materials, topological insulators and ultracold atomic gases. These systems offer the fascinating challenge of understanding the interplay between quantum interference, strong correlations, topology and nonequilibrium dynamics. Furthermore, they are important as the basic building blocks of future devices, including quantum simulators and quantum computers.



# Prof. Diana Golodnitsky

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## Research Title

**Nanomaterials and thin films for electrochemical energy storage and conversion**

## Selected Publications

1. Moran Balaish, Emanuel Peled, Diana Golodnitsky and Yair Ein-Eli, Liquid-free lithium-oxygen batteries, Angewandte Communications, 54, 2 ,436–440 (2015).
2. E. Zygadło-Monikowska, Z. Florjańczyk, J. Ostrowska, E. Peled and D. Golodnitsky, Synthesis and characterization of lithium-salt complexes with difluoroalkoxyborates for application as lithium electrolytes. Electrochimica Acta, 175, 104-112 (2015).
3. K. Goldshtein, K. Freedman, D. Schneier, L. Burstein, V. Ezersky, E. Peled and D. Golodnitsky, Advanced multiphase silicon-based anodes for high-energy-density Li-ion batteries, Journal of The Electrochemical Society, 162 (6) A1072-A1079 (2015).
4. E. Peled, F. Patolsky, D. Golodnitsky, K.Freedman, G. Davidi, D. Schneier, Tissue-like silicon nanowires-based three-dimensional anodes for high-capacity lithium-ion batteries, DOI: 10.1021/acs.nanolett.5b0074, Nano Lett. (2015).
5. R. Blanga, L. Burstein, M. Berman, S. G. Greenbaum, and D. Golodnitsky, Solid poolymer-in-ceramic electrolyte formed by electrophoretic deposition, Journal of The Electrochemical Society, 162 (11) D3084-D3089,(2015) FOCUS ISSUE ON ELECTROPHORETIC DEPOSITION.
6. D. Golodnitsky, E. Strauss, E. Peled, S. Greenbaum, Review – On order and disorder in polymer electrolytes, Journal of The Electrochemical Society, 162 (14) A1-A16 (2015) commissioned paper.
7. D. Golodnitsky, E. Strauss, T. Ripenbein, PSi-based supercapacitors in the book "Porous Silicon: From Formation to Application", v.3 Chapter 16, (2016), 345-372.

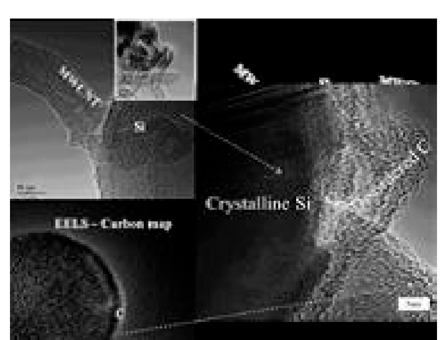
## Research Description

My major research activities focus on the synthesis and characterization of materials and the study of ion-transport phenomena in new nanostructured electrodes and solid electrolytes for energy-storage devices.

The microelectronics industry is continually reducing the size of its products in order to produce small devices such as medical implants, microsensors, self-powered integrated circuits or microelectromechanical systems. Such devices need rechargeable microbatteries with dimensions on the scale of 1–10mm$^3$, high energy density and high power capability.

A 3D concentric microbattery on a Si chip or on 3D-printed polymer substrates enables the fabrication of a network of 10,000-30,000 units connected in parallel, minimizing the ion-path length between the electrodes, and providing high capacity per footprint area. This is achieved by the insertion of four consecutive thin-film battery layers into the high-aspect-ratio microchannels of the perforated chip or polymer. For the first time, the electrophoretic deposition (EPD) method is exploited for the preparation of thin-film active battery materials. Different solvents and surface-active agents are tested, with the aim of achieving well-dispersed nanoparticles in stable suspensions. Such systems are controlled by the complex interplay of concomitant phenomena, including micellization, association of the surfactant with the polymer and adsorption of the surfactant on the species. Of particular interest is the effect of these cooperative interactions on the structure and ion-transport properties of polymer electrolytes confined in the pores of ceramics. 3D-tomography tests (carried out in collaboration with Imperial College, London) provide the data sets for the calculation of the tortuosity factor at sub-100nm resolution. To produce core-shell and multiphase ceramic/alkali-metal salt nanoparticles, the method of mechanochemistry is used.

Very recent subjects under investigation include redox processes in a high-energy-density all-solid-state lithiated Si/S battery (together with Prof. Emanuel Peled), and adsorption phenomena in supercapacitors based on porous silicon nanostructures.



# Prof. Michael Gozin

**Affiliation:** Chemistry
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### Research Title

**Development of new energetic materials and nanomaterials**

### Selected Publications

1. Synthesis of denser energetic metal-organic frameworks via a tandem anion-ligand exchange strategy; Zhang, Jichuan; Su, Hui; Dong, Yalu; Zhang, Pengcheng; Du, Yao; Li, Shenghua; Gozin, Michael; Pang, Siping; Inorganic Chemistry (2017), 56(17), 10281-10289.
2. Green energetic nitrogen-rich salts of 1,1'-Dinitramino-5,5'-bistetrazolate; He, Piao; Wu, Le; Wu, Jinting; Wang, Qianyou; Li, Zhimin; Gozin, Michael; Zhang, Jianguo; Chemistry - A European Journal (2017), 23(46), 11159-11168.
3. Alkali and alkaline earth metal salts of tetrazolone: structurally interesting and excellently thermostable; He, Piao; Wu, Le; Wu, Jin-Ting; Yin, Xin; Gozin, Michael; Zhang, Jian-Guo; Dalton Transactions (2017), 46(26), 8422-8430.
4. Energetic isomers of 1,2,4,5-tetrazine-bis-1,2,4-triazoles with low toxicity; Shlomovich, A.; Pechersky, T.; Cohen, A.; Yan, Q. L.; Kosa, M.; Petrutik, N.; Tal, N.; Aizikovich, A.; Gozin, M.; Dalton Transactions (2017), 46(18), 5994-6002.
5. Jellyfish-derived polymer; Belgorodsky, Bogdan; Fadeev, Ludmila; Hendler, Netta; Mentovich, Elad; Gozin, Michael; Richter, Shachar; Reshef-Steinberger, Liron; Nudelman, Roman; Gulakhmedova, Tamilla; U.S. Pat. Appl. Publ. (2015), US 20150335014 A1 20151126.

### Research Description

My group focuses on the development of novel energetic compounds and nanomaterials for various applications, including fire-extinguishing gas generators and materials for deep-well oil and gas extraction. We work on synthesis and comprehensive characterization of various nitrogen-rich heterocycles, related metal complexes, energetic nanomaterials based on graphene oxide derivatives and energetic three-dimensional metal organic frameworks.

# Dr. Yoni Haitin

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## Research Title

**Structural perspective of ion channel modulation**

## Selected Publications

1. Edri I., Goldenberg M., Lisnyansky M., Strulovich R., Newman H., Loewenstein A., Khananshvili D., Giladi M., Haitin Y. (2017) Overexpression and purification of human Cis-prenyltransferase in Escherichia coli. J Vis Exp., 2017.
2. James Z.M., Borst A.J., Haitin Y., Frenz B., Dimaio F., Zagotta W.N. and Veesler D. (2017). Allosteric regulation of a cyclic nucleotide-gated ion channel visualized by CryoEM. PNAS, 114, 4430-4435.
3. Haitin Y., Carlson A.E. & Zagotta W.N. (2013). Structural mechanism for regulation of KCNH channels by the eag domain. Nature, 501, 444-448.
4. Shuart N.G., Haitin Y., Camp S.S., Black K.D. & Zagotta W.N. (2011). Molecular mechanism for 3:1 subunit stoichiometry of rod cyclic nucleotide-gated ion channels. Nat Commun., 2, 457.
5. Haitin Y., Wiener R., Shaham D., Peretz A., Cohen E.B., Shamgar L., Pongs O., Hirsch J.A. & Attali B. (2009). Intracellular domains interactions and gated motions of I(KS) potassium channel subunits. EMBO J., 28, 1994-2005.

## Research Description

Every cell in our body interacts with its environment. These endless cellular conversations serve to pass information that is crucial for promoting and maintaining numerous processes, enabling the cells to respond to their changing surroundings. Concerted cellular activities, ranging from organ development, through metabolic balance, to immune response and neuronal activity, are a few examples that highlight the importance of this communication.

In this ongoing cellular talk, ion channels are the key molecular elements. These fascinating proteins facilitate the controlled passage of charged particles, the ions, through lipid membranes, which are otherwise impermeable hydrophobic barriers. Indeed, due to their critical biological roles, approximately 15% of all drugs target ion channels as their therapeutic receptors. Moreover, as in all proteins, the structural organization of ion channels is closely related to their diverse functions. Thus, it stands to reason that studying the molecular properties of these pivotal proteins is of extreme importance. Our lab focuses on understanding how ion channel structures are funneled into their specialized activities. We are interested in exposing the molecular basis for the emerging roles of ion channels in shaping the immune response, and in their contribution to facilitated cellular proliferation observed in cancerous transformation. We use molecular, biochemical and structural approaches, along with electrophysiological studies, to elucidate the modulatory mechanisms governing the function of channel families that are central to microglial activity and cancerous transformation.

# Prof. Yael Hanein

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## Research Title
**Neuro Engineering**

## Selected Publications
1. Lilach Bareket, Lilah Inzelberg, David Rand, Moshe David-Pur, David Rabinovich, Barak Brandes, and Yael Hanein, Temporary-tattoo for long-term high fidelity biopotential recordings, Sci. Rep. 6, 25727; doi: 10.1038/srep25727, (2016).
2. Lilach Bareket, Nir Waiskopf, David Rand, Gur Lubin, Moshe David-Pur, Jacob Ben-Dov, Soumyendu Roy, Cyril Eleftheriou, Evelyne Sernagor, Ori Cheshnovsky, Uri Banin, Yael Hanein, Semiconductor nanorod-carbon nanotube biomimetic films for wire-free photo-stimulation of blind retinas, Nano Letters, 14 (11), pp 6685-6692 DOI: 10.1021/nl5034304, (2014).
3. Vini Gautam, David Rand, Yael Hanein and K.S. Narayan, A polymer optoelectronic interface provides visual cues to a blind retina, Advanced Materials, 10.1002/adma.201304368. (2013).
4. Yuval Yifat, Michal Eitan, Zeev Iluz, Yael Hanein, Amir Boag, Jacob Scheuer, Highly efficcient and broadband wide-angle holography using patch-dipole nano-antenna reflect arrays, Nano Letters, 14 (5), 2485-2490, (2014).
5. David-Pur M, Bareket-Keren L, Beit-Yaakov G, Raz-Prag D, Hanein Y. (2014) All-carbon-nanotube flexible multi-electrode array for neuronal recording and stimulation. Biomed Microdevices.16(1):43-53. doi: 10.1007/s10544-013-9804-6.

## Research Description
The lab specializes in micro and nano systems. In particular, we are interested in neuronal interfaces and wearable electrophysiology.

In the last several years we developed a novel class of micro electrodes for neuronal recording and stimulation. The electrodes are fabricated by synthesizing high density carbon nanotube islands on lithographically defined, passivated titanium nitride conductors on a silicon dioxide substrate. More recently we also developed a flexible version of these electrodes. The enhanced electrochemical properties of the electrodes, their flexible and simple micro-fabrication preparation procedure, as well as their bio-compatibility and durability, suggest that carbon nanotube electrodes are a promising platform for high-resolution neuronal coupling. These electrodes are currently explored primarily for surface EMG and EEG applications.

A main focus of the lab is the development and characterization of highly efficient nanomaterial-based platforms suited for future wire-free, light induced retina implants. Our envisioned implants are soft, wireless stand-alone polymeric films embedded with photosensitive pixels. After exploring different materials, as well as different characterization and optimization methodologies, we were able to realize films that can indeed stimulate blind retinas. Presently we are working towards the implementation of these technologies as viable retinal implants.

Finally, we are working on electronic skin for electrophysiological evaluation. We recently developed novel dry electrodes, exhibiting outstanding electromyography recording along with excellent user comfort. The electrodes are realized using screen-printing of silver and carbon inks on a soft support. The conformity of the electrodes helps establish direct contact with the skin, making the use of a gel superfluous, thus supporting long-term recordings.

# Prof. Joel Hirsch

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## Research Title

**Structural biology of cellular signaling**

## Selected Publications

1. Almagor, L., Chomsky-Hecht, O., Ben-Mocha, A., Hendin-Barak, D., Dascal, N., and J. A. Hirsch. (2012). The role of a voltage-dependent Ca2+ channel intracellular linker: a structure-function analysis. J Neuroscience, 32:7602.
2. Almagor, L., Avinery, R., Hirsch, J. A.*, and R. Beck*. (2013). Structural flexibility of CaV1.2 and CaV2.2 I-II proximal linker fragments in solution. Biophys J, 104: 2392.
3. Giladi, M., Michaely, L., Almagor, L., Bar-On, D., Buki, T., Ashery, U., Khananshvili, D.*, and J. A. Hirsch*. (2013). The C2B domain is the primary Ca2+ sensor in DOC2B: a structural and functional analysis. J Mol. Biol., 425: 4629.
4. Sachyani, D., Dvir, M., Strulovich, R., Ben-Tal Cohen, E., Tria, G., Tobelaim, W., Peretz, A., Pongs, O., Svergun, D., Attali, B., and J. A. Hirsch. (2014). Structural basis of a Kv7.1 potassium channel gating module: studies of the intracellular C-terminal Domain in Complex with Calmodulin. Structure, 22: 1582.
5. Strulovich, R., Tobelaim, W.S., Attali, B., and J. A. Hirsch. (2016). Structural insights into the M-channel proximal C-Terminus/Calmodulin complex. Biochemistry, 55: 5353.

* Equally contribution

## Research Description

We focus on several molecular systems that play key roles in signal transduction. Our goal is to obtain a mechanistic understanding of: how the molecules interact, transmit and respond to various cues on the most basic level of physics and chemistry; and how this understanding can forge greater progress in comprehending the general biology to which they are pivotal.

# Prof. Oded Hod

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## Research Title

**Computational nanomaterials science**

## Selected Publications

1. R. Pawlak, W. Ouyang, A. E. Filippov, L. Kalikhman-Razvozov, S. Kawai, T. Glatzel, E. Gnecco, A. Baratoff, Q. Zheng, O. Hod, M. Urbakh, and E. Meyer, Single molecule tribology: Force microscopy manipulation of a porphyrin derivative on a copper surface, ACS Nano 10, 713-722 (2016).
2. J. E. Peralta, O. Hod, and G. E. Scuseria, Magnetization dynamics from time-dependent non-collinear spin density functional theory calculations, J. Chem. Theory Comput. 11, 3661-3668 (2015).
3. T. Zelovich, L. Kronik, and O. Hod, Molecule-lead coupling at molecular junctions: relation between the real- and state-space perspectives, J. Chem. Theory Comput. 11, 4861-4869 (2015).
4. D. Krepel, J. E. Peralta, G. E. Scuseria, and O. Hod, Graphene nanoribbons-based ultrasensitive chemical detectors, J. Phys. Chem. C 120, 3791-3797 (2016).
5. I. Oz, I. Leven, Y. Itkin, A. Buchwalter, K. Akulov, and O. Hod, Nanotubes motion on layered materials: a registry perspective, J. Phys. Chem. C 120, 4466-4470 (2016).

## Research Description

Nanoscience and nanotechnology open a unique opportunity for applying highly accurate theories to realistic material science problems. Research in my group focuses on the theoretical study of the mechanical, electronic, magnetic and transport properties of systems at the nanoscale. Using first-principles computational methods, we aim to characterize both the ground state and dynamical properties of such systems.

A combination of codes developed within our group, along with commercial computational chemistry packages, operating on a highly parallelizable high-performance computer cluster, allows us to address the properties and functionality of a variety of systems, ranging from carefully tailored molecular structures all the way to bulk systems.

In addition to questions of basic science, we pursue the design of technologically applicable nanoscale material properties, for future applications in fields such as nano-electronics, nano-spintronics, accurate and sensitive chemical sensing and nano-mechanical devices.

# Prof. Micha Ilan


| | |
|---|---|
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## Research Title

**Marine invertebrates biomineralization and skeletal properties**

## Selected Publications


1. Fuchs, Y. Aluma, M. Ilan, Y. Mastai (2014) Induced crystallization of amorphous biosilica to cristobalite by silicatein. The Journal of Physical Chemistry B 118: 2104-2111 DOI: 10.1021/jp4114317
2. Lavy, R. Keren, M. Haber, I. Schwartz, M. Ilan (2014) Implementing sponge physiological and genomic information to enhance the diversity of its culturable associated bacteria. FEMS Microbiology Ecology 87: 486–502 DOI: 10.1111/1574-6941.12240
3. M. Haber, M. Ilan (2013) Diversity and antibacterial activity of bacteria cultured from Mediterranean Axinella spp. sponges. Journal of Applied Microbiology 116: 519-532 DOI: 10.1111/jam.12401
4. Panizel, O. Yarden, M. Ilan, S. Carmeli (2013) Eight new peptaibols from sponge-associated Trichoderma atroviride. Marine Drugs 11: 4937-4960 DOI: 10.3390/md11124937
5. H. Ehrlich, P. Simon, M. Motylenko, M. Wysokowski, V.V. Bazhenov, R. Galli, A.L. Stelling, D. Stawski, M. Ilan, et al. (2013) Extreme Biomimetics: Formation of zirconium dioxide nanophase using chitinous scaffolds under hydrothermal conditions. Journal of Materials Chemistry B 1: 5092-5099 DOI: 10.1039/C3TB20676A


## Research Description

Most of the studies in my laboratory focus on Sponges (phylum Porifera) - the oldest multicellular organisms in existence, together with the natural substances they produce, and their symbiosis with other marine organisms.

Over the years we have studied many sponge species and their associates: from microorganisms (cyanobacteria, heterotrophic bacteria and fungi) through algae and invertebrates (e.g., scyphozoans, barnacles and polychaetes) to vertebrates (fish and hawksbill turtles). As filter-feeding sessile organisms, frequently non-cryptic, sponges have developed a wide array of natural products (metabolites) that assist them in dealing with their surroundings. In our laboratory we study such marine-derived natural products through two different disciplines. The first, Marine Biotechnology, investigates how the sponge produces such metabolites. The second, Chemical Ecology, examines how the sponge utilizes these compounds. Subsequently we evaluate the potential of exploiting these metabolites for human benefit, mostly as lead compounds for the development of pharmaceutical drugs.

In another line of research, Biomineralization, we investigate how organisms deposit various minerals, the ecological/physiological function of these minerals, and how we may utilize this understanding for the production of biomimetic materials.

Research in my laboratory is thus highly multidisciplinary, utilizing knowledge from fields as diverse as ecology, organic chemistry, microbiology, biochemistry, molecular biology and geochemistry. Our studies also relate to different levels of organization, from the population level through the physiological and cellular, to the molecular and chemical levels.

# Dr. Roni Ilan

**Affiliation:** Physics
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### Research Title

**Quantum transport phenomena in topological and strongly correlated matter**

### Research Description

Our areas of research include: mesoscopic and low-dimensional physics; Quantum transport phenomena; Topological phases of matter: Quantum Hall effects, topological insulators, semi-metals and superconductors; Fractional and non-Abelian quantum statistics; and Berry phase effects.

### Selected Publications:

1. Daniel Varjas, Adolfo G. Grushin, Roni Ilan, Joel E. Moore, Dynamical piezoelectric and magnetopiezoelectric effects in polar metals from Berry phases and orbital moments, Phys. Rev. Lett, 117, 257601 (2017).
2. Aaron Szasz, Roni Ilan, Joel E. Moore, Electrical and thermal transport in the quasiatomic limit of coupled Luttinger Liquids, Phys. Rev. B., 95, 85122 (2017).
3. M. R. Calvo, F. De Juan, R. Ilan, E. J. Fox, A. J. Bestwick, M. Muhlbauer, J. Wang, C. Ames, P. Leubner, C. BrNe, S. C. Zhang, H. Buhmann, L. W. Molenkamp, D. Goldhaber-Gordon, Interplay of chiral and helical states in a quantum spin hall insulator lateral junction, Phys. Rev. Lett, Arxiv:1702.08561 (2017).
4. Maja D. Bachmann, Nityan Nair, Felix Flicker, Roni Ilan, Tobias Meng, Nirmal J. Ghimire, Eric D. Bauer, Filip Ronning, James G. Analytis, Philip J.W. Moll, Inducing Superconductivity in Weyl semi-metal microstructures by selective ion sputtering, Science Advances, 3, 5 (2017).
5. Yonit Hochberg, Yonatan Kahn, Mariangela Lisanti, Kathryn M. Zurek, Adolfo G. Grushin, Roni Ilan, Sinead M. Griffin, Zhen-Fei Liu, Sophie F. Weber, Jeffrey B. Neaton, Detection of sub-meV dark matter with three-dimensional dirac materials, Arxiv:1708.08929 (2017).

# Dr. Ariel Ismach

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## Research Title

**Synthesis and characterization of 2D materials**

## Selected Publications

1. A. Ismach, H. Chou, PC. Mende, A. Dolocan, R. Addou, S. Aloni, R. Wallace, RM. Feenstra, RS. Ruoff, L. Colombo. Carbon-assisted chemical vapor deposition of hexagonal boron nitride. 2D Materials, 2017, 4, 025117.
2. H. Chou, A. Ismach, R. Ghosh, R.S. Ruoff and A. Dolocan. Revealing the planar chemistry of two-dimensional heterostructures at atomic level. Nature Communications, 2015, 6.
3. S. Z. Butler, S.M. Hollen, L. Cao, Y. Cui, J. A. Gupta, H. R. Gutiérrez, T. F. Heinz, S. S. Hong, J. Huang, A. Ismach, E. Johnston-Halperin, M. Kuno, V. V. Plashnitsa, R. D. Robinson, R. S. Ruoff, S. Salahuddin, J. Shan, L. Shi, M. G. Spencer, M. Terrones, W. Windl, and J. E. Goldberger. Progress, challenges and opportunities in two-dimensional materials beyond Graphene. ACS Nano, 2013, 7 (4), 2898–2926.
4. A. Ismach, H. Chou, D. Ferrer, Y. Wu, H.C. Floresca, S. McDonnell, A. Covacevich, C. Pope, R. Piner, R. Wallace, M. Kim, L. Colombo, R. Ruoff. Towards the controlled synthesis of hexagonal Boron Nitride films. ACS Nano, 2012, 6 (7), 6378–6385.
5. A. Ismach, C. Druzgalski, S. Penwell, M. Zheng, A. Javey, J. Bokor, Y. Zhang. Direct chemical vapor deposition of Graphene on dielectric surfaces. Nano Letters 2010, 10, 1542-1548.

## Research Description

"The future looks flat…"

**Growth mechanism studies**

The formation of 2D materials at the single- and few-layer level is very challenging, and requires basic knowledge of the processes taking place during growth. Moreover, controlled formation of 2D materials on large scales is a prerequisite for their successful integration in new and existing technologies.

To address this important issue we use Chemical Vapor Deposition (CVD) methodologies for growing Transition Metal Dichalcogenides (TMDs), mainly of the Mo and W families ($MoX_2$ and $WX_2$; X = S, Se and Te). Some basic questions we try to address: How does the surface influence growth? How does the precursor type (solid, liquid or gas – volatile or not, etc.) influence growth? What are the requirements for growing a single layer over large areas (surface-mediated growth, layer-by-layer, 3D islands growth, etc.)? Furthermore, we aim to grow more exotic layered materials, not achieved so far.

**In-situ and ex-situ doping and alloying of 2D materials**

The chemical composition of materials in general greatly affects their electronic and optical properties. Here we aim to control the chemical composition of layered materials during or after their formation. We use various techniques to characterize the doping and alloying processes: Raman Spectroscopy and mapping, Photoluminescence Spectroscopy, XPS, EDS, TOF-SIMS, etc.

**Controlled formation of vertical and horizontal heterostructures**

Heterostructures made of single- or few- atom-thick materials have attracted a wide interest in the scientific community, due to their potential in nanoelectronics and optoelectronics. Here we employ the lessons learned from the previous tasks to create novel vertical and horizontal heterostructures. This is followed by a full structural, chemical, electrical and optoelectrical characterization.

**How do mechanical strains, temperature and the chemical environment affect intrinsic properties?**

Commercial and home-made cells are used to address the above questions with regard to synthesized materials. These questions are crucial for the integration of such materials into different technologies, as well as for the development of new devices (such as sensors, electrical switches, etc.).

**When 2D meets 3D: the formation of novel 3D structures**

Here we aim to create novel functional 3D materials made of 2D layered materials for a wide range of applications, such as ultra-light and ultra-strong materials, thermal management, composite materials, catalysis, electrodes in supercapacitors and batteries and more.

# Prof. Amit Kohn

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## Research Title

**Magnetic and electronic materials used for information storage devices; Transmission electron microscopy; Electron holography**

## Selected Publications

1. Chalasani R, Pekin A, Rabkin A, Abutbul RE, Diéguez O, Kauffmann Y, Golan Y, Kohn A. Mapping charge distribution in single PbS core - CdS arm nano-multipod heterostructures by off-axis electron holography, Nano Lett. 2017 May 10;17(5):2778-2787. doi: 10.1021/acs.nanolett.6b04957.
2. Kohn A, Habibi A, Mayo M., Ultramicroscopy: Experimental evaluation of the 'transport-of-intensity' equation for magnetic phase reconstruction in Lorentz transmission electron microscopy, 2016 Jan;160:44-56. doi: 10.1016/j.ultramic.2015.09.011.
3. Ruchlemer R, Amit-Kohn M, Raveh D, Hanuš L., Inhaled medicinal cannabis and the immunocompromised patient, Support Care Cancer. 2015 Mar;23(3):819-22. doi: 10.1007/s00520-014-2429-3.

## Research Description

My work focuses on magnetic and electronic materials used for information storage devices. My scientific contributions address the relations between the structure, composition and electronic structure of these materials and the magneto-transport properties of the devices. Thus, my engineering objectives are improving or designing new spin-electronic devices. Structural and chemical characterization is achieved by analytical transmission electron microscopy, which probes the composition, structure, and electronic properties of the materials at the nanoscale, down to the atomic level.
Additionally, I apply and develop electron holography and Lorentz transmission electron microscopy in order to image electrostatic and magnetic fields in materials and devices at the nanoscale.

# Prof. Alexander Kotlyar

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## Research Title

**DNA-based nanotechnology**

## Selected Publications

1. Eidelshtein, G., Fardian-Melamed, N., Gutkin, V., Basmanov, D., Klinov, D., Rotem, D., Levi-Kalisman, Y., Porath, D. and Kotlyar, A. (2016). Synthesis and properties of novel silver containing DNA molecules. Adv Mater. 2016 Jun;28(24):4944.
2. Eidelshtein, G., Kotlyar, A., Hashemi, M. and Gurevich, G. (2015). Aligned deposition and electrical measurements on single DNA molecules. Nanotechnology 475102 (8pp).
3. Livshits, G.I., Stern, A., Rotem, D., Borovok, N., Eidelshtein, G., Migliore, A., Penzo, E., Wind, S.J., Di Felice, R., Skourtis, S.S., Cuevas, J.C., Gurevich. L., Kotlyar, A.B., Porath and D. (2014). Long-range charge transport in single G4-DNA molecules. Nature Nanotechnology 9, 1040-1046.
4. Livshits, G.I., Ghabboun, J., Borovok, N., Kotlyar, A.B. and Porath D. (2014). Comparative electrostatic force microscopy of tetra-and intra-molecular G4-DNA. Advanced Materials 26, 4981–4985.
5. Halamish, S., Eidelshtein, G. and Kotlyar, A. (2013) Plasmon-coupled nanostructures comprising finite number of gold particles. Plasmonics 8, 745-748.

## Research Description

### DNA-BASED NANOTECHNOLOGY

The DNA molecule, well known from biology for containing the genetic code of all living species, has caught the attention of chemists and physicists as a possible candidate for wiring electronic materials in a programmable way. Self-assembled DNA-based conductive architectures can reduce the size of current electronic devices by ~1000 times, while shifting the production process from complicated and defect-rich lithography to processes based on self-assembly and self-organization. However, the double stranded (ds) random sequenced DNA lacks the desirable feature of conductivity. To meet this challenge, we develop new conductive molecular nanowires based on G4-DNA, E-DNA (a hybrid of DNA strands and silver atoms) and thin gold-coated DNA nanowires. All of these can be assembled into complex 2D and 3D DNA architectures, forming a foundation for DNA-based nano-circuits and nano-devices.

### BIOMEDICAL APPLICATIONS OF PLASMONIC NANOPARTICLE STRUCTURES

Noble metal nanoparticles attract huge scientific interest due to their attractive electronic, optical, chemical and thermal properties. In particular, these particles have been successfully used in therapy and diagnostics of cancer. Our research focuses specifically on gold nanoparticles coated with DARPin _9-29, an ankyril repeat protein specifically designed to target human epidermal growth factor receptor 2 (HER2), which is overexpressed in breast cancer. We have demonstrated that the interaction of spherical gold nanoparticles (GNPs) with DARPin _9-29 yields very stable GNP-DARPin conjugates that do not aggregate at physiological salt concentrations, interact specifically with the surface of SK-BR-3 cells that overexpress receptor HER2, and are efficiently transferred into them by endocytosis. Moreover, we have demonstrated that illumination of the DARPin-GNP-treated SK-BR-3 cells with red light (633 nm) leads to significant cell death. Specific eradication of cancer cells using GNP-DARPin conjugates paves the way to novel photodynamic approaches for specific treatment of cancer.

# Prof. Slava Krylov

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## Research Title

**Design and modeling of micro and nano systems (MEMS/NEMS)**

## Selected Publications

1. S. Krylov, B. R. Ilic, D. Schreiber, S. Seretensky and H. Craighead, Pull-in behavior of electrostatically actuated bistable microstructures, Journal of Micromechanics and Microengineering, 18, paper 055026, 2008.
2. S. Krylov, Lyapunov exponents as a criterion for the dynamic pull-in instability of electrostatically actuated microstructures, Int. Journal of Non-Linear Mechanics, 42, 626 – 642, 2007.
3. S. Krylov, Y. Gerson, T. Nachmias, U. Keren, Excitation of large amplitude parametric resonance by the mechanical stiffness modulation of a microstructure, Journal of Micromechanics and Microengineering, 20, 015041 (12pp), 2010.
4. S. Krylov, S. Lulinsky, B. R. Ilic, I. Schneider, Collective dynamics and pattern switching in an array of parametrically excited micro cantilevers interacting through fringing electrostatic fields, Applied Physics Letters, 105, 071909, 2014.
5. Y. Kessler, S. Krylov, A. Liberzon, Flow sensing by buckling monitoring of electrothermally actuated double-clamped micro beams, Applied Physics Letters, 109(8), 2016, pap. 083503.

## Research Description

My research in the area of design and modeling of micro- and nanoelectromechanical systems (MEMS/NEMS) combines theoretical and applied aspects. The overall scope of my work encompasses the development of new approaches to actuation and sensing, and their implementation in micro and nano devices such as: electrostatically, magnetically and thermally actuated, parametrically excited resonators, inertial, mass, bio and chemical sensors, flow sensors, tilting mirrors, bistable and multistable devices and polymeric MEMS.

# Prof. Ron Lifshitz

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## Research Title

**Nanomechanics And Quasicrystal**

## Selected Publications

1. Ron Lifshitz and M.C. Cross, "Nonlinear dynamics of nanomechanical resonators.›› In Nonlinear Dynamics of Nanosystems, Eds. G. Radons, B. Rumpf, and H.G. Schuster (Wiley-VCH, Weinheim, 2010) Ch. 8.
2. Eyal Kenig, M.C. Cross, Ron Lifshitz, R.B. Karabalin, L.G. Villanueva, M.H. Matheny, and M.L. Roukes, "Passive phase noise cancellation scheme." Phys. Rev. Lett. 108 (2012) 264102.
3. Itamar Katz, Alex Retzker, Raphael Straub, and Ron Lifshitz, "Signatures for a classical to quantum transition of a driven nonlinear nanomechanical resonator." Phys. Rev. Lett. 99 (2007) 040404.
4. Ron Lifshitz, A. Arie, and A. Bahabad, "Photonic quasicrystals for nonlinear optical frequency conversion," Phys. Rev. Lett. 95 (2005) 133901.
5. K. Barkan, M. Engel, and Ron Lifshitz, "Controlled self-assembly of periodic and quasiperiodic cluster crystals," Phys. Rev. Lett. 113 (2014) 098304.

## Research Description

### Nanomechanics

With recent advances in nanotechnology, state of the art nanoelectromechanical and nano-optomechanical systems can now be fabricated with lateral dimensions down to a few nanometers, and combined with self-assembled nanostructures such as carbon nanotubes and graphene. Among other things, this enables normal frequencies that routinely exceed 1 GHz. As a consequence, they are no longer simply smaller and improved versions of their micron-scale siblings, but also offer great opportunities for the study of mechanics in physical regimes that previously had been inaccessible experimentally. My group—in a long-standing collaboration with the groups of Profs. Michael Roukes and Michael Cross at Caltech—is concerned with the theoretical study of nanomechanical systems. These studies cover a broad range of topics, ranging from the mesoscopic physics of phonons and their interaction with electrons, the classical nonlinear dynamics of coupled nanomechanical resonators, and the quantum behavior of human-made nanoscale devices.

### Quasicrystals

The group is also involved in unrelated theoretical research in the field of quasicrystals. These crystals—which are not periodic but nevertheless possess perfect long-range order—offer interesting opportunities for studies at the nanoscale. One particular direction that has been pursued by the group, partly in collaboration with Haim Diamant of the School of Chemistry, and with Michael Engel of the Friedrich Alexander University in Erlangen-Nürnberg, is the thermodynamic stability of quasicrystals made of soft macromolecules and their controlled self-assembly. A second direction, which was pursued in collaboration with Profs. Ady Arie and Alon Bahabad of the School of Electrical Engineering at TAU, is the use of artificially fabricated nonlinear photonic quasicrystals for the purpose of optical frequency conversion.

# Dr. Yoav Linzon



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## Research Title

**Optical MEMS, NEMS, silicon and fiber-based resonators, actuators and controllers**

## Selected Publications


1. D.J. Joe, Y. Linzon, V.P. Adiga, R.A. Barton, M. Kim, B. Ilic, S. Krylov, J.M. Parpia, and H.G. Craighead, Stress-based resonant volatile gas microsensor operated near the critically-buckled state, Journal of Applied Physics 111, 104517 (2012).
2. Y. Linzon, D.J. Joe, B. Ilic, J. Topolancik,, J.M. Parpia, H.G. Craighead, and S. Krylov, Synchronous imaging for rapid visualization of complex vibration profiles in electromechanical microresonators, Journal of Applied Physics 111, 023507 (2012).
3. S. Mahajne, D. Guetta, S. Lulinsky, S. Krylov, and Y. Linzon, Liquid mass sensing using resonating microplates under harsh drop and spray conditions, Physics Research International 320324, 1-8 (2014).
4. Y. Linzon, S. Lulinsky, B. Ilic, and S. Krylov, Efficient parametric excitation of silicon-on insulator microcantilever beams by fringing electrostatic fields, Journal of Applied Physics 113, 163508 (2013).
5. D. Southworth, L.M. Bellan, Y. Linzon, J.M. Parpia, and H.G. Craighead, Stress-based vapor sensing using resonant microbridges, Applied Physics Letters 96, 163503 (2010).


## Research Description

Micro- and nano- opto-mechanically based systems (MOEMS and NOEMS) are useful due to their potential sensitivity, speed, energy efficiency and density, as well as their potential for low-cost integration into systems. We develop emerging applications of MOEMS/NOEMS that comply with industry standards and advanced R&D settings - where device design, fabrication and testing are key to successful next-generation deployment.

# Dr. Hadas Mamane



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## Research Title

**Development of novel technologies for water treatment and renewable energy, by introducing natural and induced photons, radicals and nanoparticles into the water**

## Selected Publications

1. Luster, E., Avisar, D., Horovitz, I., Lozzi, L., Baker, M.A., Grilli, R. and Mamane, H. (2017). N-doped TiO2-coated ceramic membrane for Carbamazepine degradation in different water qualities. Nanomaterials, 31, 7(8).
2. Peretz, R., Gerchman, Y., and Mamane, H. (2017). Ozonation of tannic acid to model biomass pretreatment for bioethanol production. Bioresource Technology.1060-1066 ,241 .
3. Horovitz, I., Avisar, D., Grilli, R., Enevoldsen, A.D., Di Camillo, D., Baker, M.A., Lozzi, L. and Mamane, H. (2016) Carbamazepine degradation using an N-doped TiO2-coated photocatalytic membrane reactor: influence of physical parameters. Journal of Hazard
4. Nizri, L., Vaizel-Ohayon, D., Ben-Amram, H., Sharaby, Y., Halpern, M. and Mamane, H. (2017) Development of a molecular method for testing the effectiveness of UV systems on-site. Water Research, 127, 15, 162-171.
5. Zucker, I., Lester, Y., Avisar, D., Hübner, U., Jekel, M., Weinberger, Y. and Mamane, H. (2015) Influence of wastewater particles on ozone degradation of trace organic contaminants, Environmental Science & Technology 49, 301-308.

## Research Description

My research addresses one of humanity's major challenges today: making safe drinking water available to all. Conducting both theoretical and experimental (laboratory and field) studies, I focus on developing water-treatment processes and technologies. Specifically, I introduce natural and induced photons, radicals and nanoparticles into water, and investigate the effects of these reactive particles on the kinetics and mechanisms of microbial inactivation, biofouling control and chemical oxidation.

Studies currently conducted in my laboratory include:

- Photolysis, photocatalysis and oxidation of hospital, chemical, industrial and agricultural waste water, using Advanced Oxidation Processes (AOPs) based on ultraviolet (UV) radiation, photocatalysts and ozone particles
- Biofouling control in water using AOPs and nanoparticles
- Shape analysis of nano and micron particles in water undergoing various treatments, such as granular and membrane filtration and AOPs
- Re-use technologies based on hybrid biofiltration, ozonation and short Soil Aquifer Treatment (SAT) of secondary effluent
- Nanostructured solar Photocatalytic Membrane Reactors (PMRs) for water treatment
- Tools for assessing AOPs, such as fluorescence-tagged viruses and gene expression
- Pretreatment of lignocellulosic biomass such as agricultural waste, paper and olive-oil waste, via AOPs and bioethanol and CNC production
- Molecular methods that use DNA damage to test the effectiveness of UV systems and reactors on-site
- Biosensors for monitoring the induction of selected genes in real time by UV and AOP

# Prof. Rimona Margalit

**Affiliation:** Life Sciences
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## Research Title

**Biomaterial-based targeted carriers for theranostics of cancer and inflammation**

## Selected Publications

1. Ben-Mordechai T, Palevsky D, Glucksam-Galnoy Y, Elron-Gross I, Margalit R, Leor J (2015). Targeting macrophage subsets for infarct repair. Journal of Cardiovascular Pharmacology and Therapeutics 20, 36-51.
2. Ilia Rivkin, Yifat Galnoy-Glucksam, Inbar Elron-Gross, Amichay Afriat, Arik Eisenkraft, Rimona Margalit (2016) Treatment of respiratory damage in mice by aerosols of drug-encapsulating targeted lipid-based particles. Journal of Cont. Rel. in publication, on line April 2016
3. Rimona Margalit and Dan Peer (2016). Lipidated glycosaminoglycan particles and their use in drug and gene delivery for diagnosis and therapy. US patent # 9,259,474

## Research Description

Our group applies three lipid-based particulate drug carriers for theranostics of major pathology classes - all invented and developed 'in-house'. Four such projects are currently running at the lab, and each project includes three stages: (i) Formulation studies – making the drug-carrier systems and characterizing them through structural and physicochemical studies; (ii) In vitro studies in cultures of the relevant target and control cell lines, pursuing safety and retention of therapeutic activity of the carrier-encapsulated drug; and (iii) In vivo studies in appropriate animal models, pursuing safety and efficacy. Our current projects include:

1) Inhalational treatment of respiratory damage by aerosols of hyaluronan-liposomes encapsulating anti-inflammatory and anti-oxidant drugs - a single drug or both in the same liposome. This is currently at the in vivo stage, evaluating safety and efficacy in a mouse model for acute lung inflammation.
2) Theranostics of heart inflammation (post myocardial infarction) by macrophage-targeted liposomes encapsulating iron nanoparticles, iron complexes or steroids. This project, conducted in collaboration with Prof. J. Leor from TAU's Faculty of Medicine, is currently at the in vitro and in vivo stages.
3) Cancer theranostics, directed at both the cancer cells and the tumor-associated macrophages, by hyaluronan-liposomes encapsulating iron complexes. This study, also in collaboration with Prof. J. Leor, is now at the in vitro and in vivo stages.
4) Treatment of osteoarthritis via local injection, by a collagen-based carrier encapsulating anti-inflammatory drugs. This is in the initial stage of formulation studies.

# Prof. Gil Markovich

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## Research Title

**Physical properties of colloidal inorganic nanocrystals**

## Selected Publications

1. Amir Hevroni, Mukund Bapna, Stephan Piotrowski, Sara A. Majetich, Gil Markovich, Tracking the Verwey transition in single magnetite nanocrystals by variable-temperature scanning tunneling microscopy, J. Phys. Chem. Lett. 7, 1661–1666 (2016).
2. Amir Hevroni, Boris Tsukerman, Gil Markovich, Probing magnetization dynamics in individual magnetite nanocrystals using magnetoresistive scanning tunneling microscopy, Phys. Rev. B 92, 224423 (2015).
3. Assaf Ben-Moshe, Sharon Grayer Wolf, Maya Bar Sadan, Lothar Houben, Zhiyuan Fan, Alexander O. Govorov, Gil Markovich, Enantioselective control of lattice and shape chirality in inorganic nanostructures using chiral biomolecules, Nature Comm. 5, 4302 (2014).
4. Ben M. Maoz, Yulia Chaikin, Alexander B. Tesler, Omri Bar Elli, Zhiyuan Fan, Alexander O. Govorov, Gil Markovich, Amplification of chiroptical activity of chiral biomolecules by surface plasmons, Nano Lett. 13, 1203-1209 (2013).
5. Daniel Azulai, Elad Cohen, Gil Markovich, Seed concentration control of metal nanowire diameter, Nano Lett. 12, 5552-5558 (2012).

## Research Description

We work on several interesting inorganic colloidal nanostructure systems. Currently we focus on two major projects:

1. Nanoscale chirality and optical activity: we work on different aspects of the interaction of chiral bio-molecules with inorganic nanocrystals. We study the optical activity of these systems mainly through Circular Dichroism. This reveals new information on the molecules' interaction with the surface of metal and semiconductor nanostructures. Another aspect of this work is enantio-selective synthesis of intrinsically chiral nanocrystals. Such nanocrystals have chiral atomic configurations (such as in quartz), and by preparing them with strongly interacting chiral molecules, we can selectively prepare right- or left-handed nanocrystals.

2. Metal nanowire films for transparent electrodes: We developed a simple wet chemical process for preparing very thin gold-silver nanowire films on various substrates. Such films can be used for various displays and many other applications. The films can be patterned by different printing techniques.

# Dr. Iftach Nachman

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## Research Title

**Cell fate decisions in differentiation and reprogramming**

## Selected Publications

1. Goldshmidt, Y., Yurkovsky, E., Reif, A., Rosner, R., Akiva, A., Nachman, I. (2015). Control of relative timing and stoichiometry by a master regulator. PLoS One 10(5), e012733.
2. Pour, M., Pilzer, I., Rosner, R., Smith, Z.D., Meissner, A., Nachman, I. (2015). Epigenetic predisposition to reprogramming fates in somatic cells. EMBO reports 16, 370-378.
3. Aidelberg, G., Goldshmidt, Y., Nachman, I. (2012). A microfluidic device for studying multiple distinct strains. J Vis Exp, (69), e4257, doi:10.3791/4257.
4. Smith, Z.D., Nachman, I., Regev, A., Meissner, A. (2010). Dynamic single-cell imaging of direct reprogramming reveals an early specifying event. Nature Biotechnol. May;28(5):521-6.
5. Yurkovsky, E., Nachman, I. (2013). Event timing at the single cell level. Brief Funct Genomics. 12(2):90-8.

## Research Description

Our goal is to understand how cells within a population reach developmental decisions at the phenotypic and mechanistic level: How do cells "decide" to change their state? Why do similar cells respond differently to the same signal? What properties of the cell's internal state affect its decision? What determines these properties and their spread in the cell population? What determines which cell states are stable? Our lab studies these fundamental questions in two model systems, using methods from live cell fluorescent imaging, microfluidics and statistical and computational analysis.

# Dr. Amir Natan

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## Research Title

**Multiscale simulations of materials and processes**

## Selected Publications

1. Natalia Kuritz, Michael Murat, Moran Balaish, Yair Ein-Eli, and Amir Natan, PFC and triglyme for Li-air batteries: a molecular dynamics study – Journal of Physical Chemistry B (2016) DOI: 10.1021/acs.jpcb.5b12075.
2. Nicholas Boffi, Manish Jain and Amir Natan, Asymptotic behavior and interpretation of virtual states: the effects of confinement and of basis sets – J. Chem. Phys. 144, 084104 (2016).
3. M. Zuzovski, A. Boag and A. Natan, Auxilliary grid method for the calculation of electrostatic terms in Density Functional Theory on a real-space grid, PCCP, 17, 31510, (2015).
4. Yevgeny Rakita, Diana Golodnitsky, Amir Natan, Electrostatic potential of polyelectrolyte molecules grafted on charged surfaces: A Poisson-Boltzmann model, Journal of Electrochemical Society 161 (8), E3049-E3058, (2014).
5. Amir Natan, Ayelet Benjamini, Doron Naveh, Leeor Kronik, Murilo L. Tiago, Scott P. Beckman,and James R. Chelikowsky, Real Space Pseudopotential method for first principles calculations of general periodic and partially periodic systems, Phys. Rev. B 78, 075109 (2008).

## Research Description

The goal of our lab is to develop and use multiscale models for materials, interfaces and processes for energy applications. We also aim to bridge between atomistic quantum and classical models and larger-scale continuum equations that will eventually allow us to simulate a whole device. We develop formalism and code within the real-space PARSEC Density Functional Theory (DFT) and the time dependent DFT (TDDFT) package, and aim to achieve very fast calculations of FOCK exchange and post Hartree-Fock methods for large systems. Combining DFT and classical Molecular Dynamics (MD) we model materials and processes for future batteries and photovoltaic applications. We also use machine learning strategies and DFT to improve future MD simulations for such materials. Data mining strategies are used to search for and select new metal oxide materials, and to associate their structure with some desired properties.

# Prof. Abraham Nitzan

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## Research Title

**Theoretical aspects of chemical dynamics**

## Selected Publications

1. A. Migliore and A. Nitzan, Irreversibility in redox molecular conduction: single versus double metal-molecule interfaces, Electrochimica Acta 160, 363–375 (2015).
2. K. Kaasbjerg and A. Nitzan, Theory of light emission from quantum noise in plasmonic contacts: above-threshold emission from higher-order electron-plasmon scattering, Phys. Rev. Letters, 114, 126803 (2015).
3. W. Dou, A. Nitzan and J. E. Subotnik, Surface hopping with a manifold of electronic states, II. Application to the many-body Anderson-Holstein model, J. Chem. Phys. 142, 084110 (2015).
4. K. Kaasbjerg and A. Nitzan, Theory of light emission from quantum noise in plasmonic contacts: above-threshold, emission from higher-order electron-plasmon scattering, Phys. Rev. Letters, 114, 126803 (2015).
5. W. Dou, A. Nitzan and J. E. Subotnik, Surface hopping with a manifold of electronic states, III: transients, broadening and the Marcus picture, J. Chem. Phys. 142, 234106 (2015).

## Research Description

Research in my group focuses on theoretical aspects of chemical dynamics. This branch of chemistry describes the nature of physical and chemical processes underlying the progress of chemical reactions, with the aim of understanding such processes and being able to predict their course of evolution. In particular, our studies deal with chemical processes involving interactions between light and matter, chemical reactions in condensed phases and at interfaces, and transport phenomena in complex systems. Our main research emphases are:

- Energy transfer processes in molecular systems
- Molecular dynamics in condensed phases
- Ionic transport in complex environments
- Optical properties and photochemistry of adsorbed molecules
- Electron transport through molecular layers and wires
- Classical and quantum thermodynamics of energy conversion processes

# Dr. Vered Padler-Karavani

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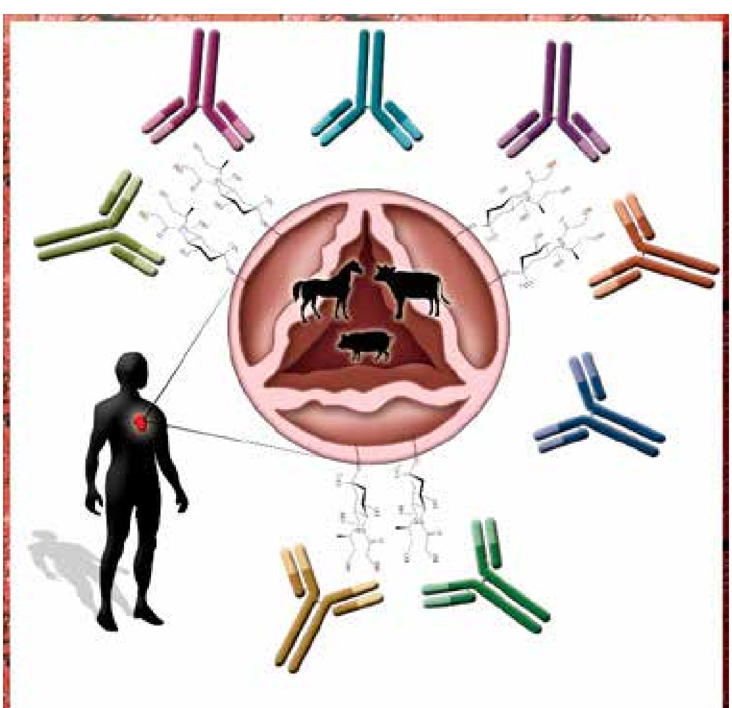
## Research Title

**Glycans in immune recognition and response**

## Selected Publications

1. Amon R, Reuven EM, Leviatan Ben-Arye S, Padler-Karavani V. (2014). Glycans in immune recognition and response. Carbohydr Res. 389:115-22.
2. Padler-Karavani V. (2014). Aiming at the sweet side of cancer: aberrant glycosylation as possible target for personalized-medicine. Cancer Lett. 28;352(1):102-12.
3. Scobie L#, Padler-Karavani V#, Le Bas-Bernardet S, Crossan C, Blaha J, Matouskova M, Hector RD, Cozzi E, Vanhove B, Charreau B, Blancho G, Bourdais L, Tallacchini M, Ribes JM, Yu H, Chen X, Kracikova J, Broz L, Hejnar J, Vesely P, Takeuchi Y, Varki A, Soulillou JP. (2013). Long-term IgG response to porcine Neu5Gc antigens without transmission of PERV in burn patients treated with porcine skin xenografts. J Immunol. 191(6):2907-15 (# equally contributed).
4. Padler-Karavani V#, Song X#, Yu H, Hurtado-Ziola N, Huang S, Muthana S, Chokhawala HA, Cheng J, Verhagen A, Langereis MA, Kleene R, Schachner M, de Groot RJ, Lasanajak Y, Matsuda H, Schwab R, Chen X, Smith DF, Cummings RD, Varki A. (2012). Cross-comparison of protein recognition of sialic acid diversity on two novel sialoglycan microarrays. J Biol Chem. 287(27):22593-608 (# equally contributed).
5. Padler-Karavani V, Hurtado-Ziola N, Pu M, Yu H, Huang S, Muthana S, Chokhawala HA, Cao H, Secrest P, Friedmann-Morvinski D, Singer O, Ghaderi D, Verma IM, Liu YT, Messer K, Chen X, Varki A, Schwab R. (2011) Human xeno-autoantibodies against a non-human sialic acid serve as novel serum biomarkers and immunotherapeutics in cancer. Cancer Res. 71(9):3352-63.



## Research Description

Our lab studies the mechanisms that govern glycan immune recognition and responses in animal models and humans, both in vitro and in vivo. We combine glycobiology, immunology, biotechnology and cancer research, and use cutting-edge technologies within these disciplines, including glycan microarray and glyco-nanotechnology.

Current interests include:

- Immunological mechanisms of unique anti-carbohydrate antibodies
- Glyco-immunology in xenotransplantation, which we investigate as members of the EU TRANSLINK Consortium
- Anti-carbohydrate antibodies in mucosal secretions and sera
- Developing novel diagnostics and therapeutics for chronic inflammation-mediated diseases.
- Developing bio-nanotechnology tools based on glycan recognition, as members of the Focal Technology Area (FTA) on Nanomedicines for Personalized Theranostics Consortium and the Tel Aviv University Center for Nanoscience & Nanotechnology.
- Identifying and characterizing Tumor-Associated Carbohydrate Antigens (TACA), as members of the Cancer Biology Research Center (CBRC).

# Prof. Alexander Palevski

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## Research Title

**Quantum electronic transport in low dimensional systems**

## Selected Publications

1. R. Hevroni, V. Shelukhin, M. Karpovski, M. Goldstein, E. Sela, Hadas Shtrikman and A. Palevski (2016). Suppression of Coulomb blockade peaks by electronic correlations in InAs nanowires, Phys. Rev. B 93, 035305.
2. E. Maniv, M. Ben Shalom, A. Ron, M. Mograbi, A. Palevski, M. Goldstein, and Y. Dagan (2015). Strong correlations elucidate the electronic phase-diagram of LaAlO3/SrTiO3 interface, Nature Communications, 6, 8239.
3. Qi I. Yang, Merav Dolev, Li Zhang, Jinfeng Zhao, Alexander D. Fried, Elizabeth Schemm, Min Liu, Alexander Palevski, Ann F. Marshall, Subhash H. Risbud, and Aharon Kapitulnik (2013). Emerging weak localization effects on a topological insulator–insulating ferromagnet (Bi2Se3-EuS) interface.Phys. Rev. B 88, 081407(R).
4. Nicholas P. Breznay, Hanno Volker, Alexander Palevski, Riccardo Mazzarello, Aharon Kapitulnik, and Matthias Wuttig (2012). Weak antilocalization and disorder-enhanced electron interactions in annealed films of the phase-change compound GeSb2Te4. Phys.Rev. 73.
5. I. Sternfeld, E. Levy, M. Eshkol, A. Tsukernik, M. Karpovski, Hadas Shtrikman, A. Kretinin, and A. Palevski, (2011). Magnetoresistance oscillations of superconducting Al-film cylinders covering InAs nanowires below the quantum critical point, Phys. Rev. Lett.

## Research Description

Our research involves quantum electronic transport in condensed matter systems at low temperatures. Topics are quite diverse, spanning many areas of modern solid state physics: superconductivity, ferromagnetism, the Quantum Hall effect and mesoscopic physics. Due to the diversity of subjects, the materials investigated also cover a broad range of solids: normal metals, ferromagnets, semiconductors, topological insulators and superconductors. The common denominator of the devices made of these material systems at our lab is low dimensionality - a vast majority of the experimentally studied electronic systems are either two- or one-dimensional. The low dimensions of the devices fabricated in the lab are achieved via state-of-the-art nanofabrication techniques, including photolithography, electron beam lithography, focused ion beam microscopy and more.

In recent years research at the lab has focused mainly on the following topics:

- Mesoscopic phenomena and superconductivity in two-dimensional electron gas formed at the interface between the two large gap insulators $SrTiO_3$/$LaAlO_3$ and in topological insulators $BiSe_3$. Quantum interference effects were observed and analyzed, allowing us to establish the dephasing mechanism in these exotic systems.
- The electronic correlations in InAs and GaAs semiconductor nanowires. The role of the electron-electron interaction was elucidated, and the so-called Luttinger liquid model was demonstrated as the adequate theory for transport in quantum nanowires.
- Spin-orbit interaction and its effect on quantum transport in nanowires, and the role played in quantum interference phenomena in Aharonov Bohm rings. Currently we are studying the effect of the spin orbit interaction on Luttinger parameter on Berry phase in these systems.

# Prof. Fernando Patolsky

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## Research Title

**The synthesis and characterization of new nanoscale materials for the development of nanoelectronic, electro-optic and electro-magneto-optical devices and their applications in biology, chemistry and technology**

## Selected Publications

1. Y. Engel , R. Elnathan , A. Pevzner , G. Davidi , E. Flexer and F. Patolsky, Supersensitive detection of explosives with silicon nanowire arrays, Angew. Chem. Int. Ed., 49, 6830-6835, (2010). Hot Paper with Cover Page !
2. A. Pevzner, G. Davidi, H. Peretz-Soroka, E. Havivi, Z. Barkay, R. Popovitz-Biro, A. Khatchtourints and F. Patolsky, Unwrapping core-shell nanowires into nanoribbon-based superstructures, Angewandte Chemie, (2013), 52, 11298–11302.
3. F. Patolsky, B.P. Timko, G. Yu, Y. Fang, A.B. Greytak, G. Zheng and C.M. Lieber, Detection, stimulation and inhibition of neuronal signals with high-density nanowire transistor arrays, Science 313 1100-1104 (2006).
4. Amir Lichtenstein, Ehud Havivi, Ronen Shacham, Ehud Hahamy, Ronit Leibovich, Alexander Pevzner, Vadim Krivitsky, Guy Davivi, Igor Presman, Roey Elnathan, Yoni Engel, Eli Flaxer & Fernando Patolsky, Supersensitive fingerprinting of explosives by chemically modified nanosensors arrays, Nature Comm., 5:4195, (2014).

## Research Description

Prof. Fernando Patolsky's research group in the School of Chemistry is a young, dynamic scientific team, always seeking excellence and challenging research.

Nanoscience and Nano-Biotechnology are our main fields of interest and specialization. Our work focuses on applied research for the development of novel applications and technologies. We cover the entire spectrum, from the basics of nanoscience and nanostructure synthesis, to the development of ultrasensitive sensors and biosensors for detecting molecular and biomolecular footprints. In particular, we are interested in coupling biological phenomena with chemical reactions to develop new sensing and diagnostic tools.

Another area of interest is 'energy-related' research, especially the development of novel, cost-effective and efficient Fuel Cell devices.

Our group's facilities, located in several rooms within the TAU campus, and covering most of our research needs, include: our own clean-room, with all the equipment required for fabrication of nanodevices; probe stations; several sensing stations; AFM for the broad characterization of nanodevices; wet chemical labs; electrochemistry labs; biosensing labs; and a cell culture lab for growing and evaluating neural systems.

# Prof. Dan Peer

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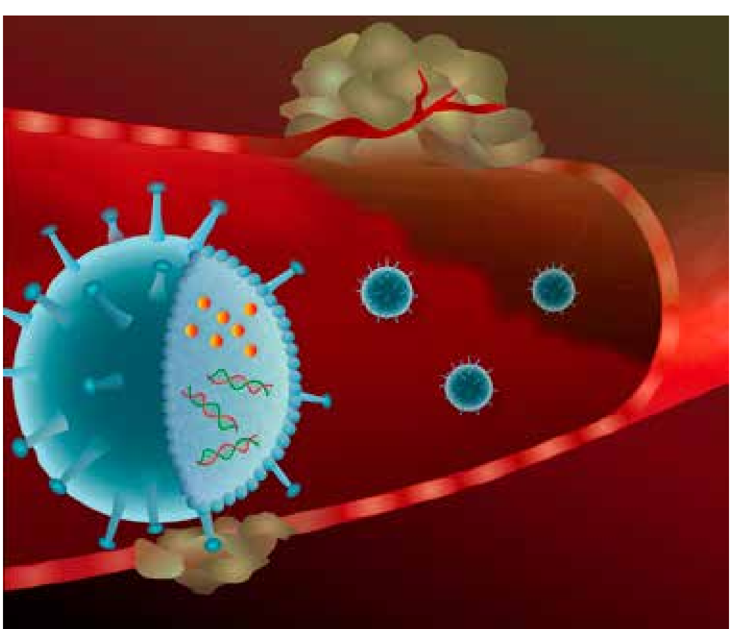
## Research Title

**Nanomedicine**

## Selected Publications

1. S. Weinstein, I.A. Toker, R. Emmanuel, S. Ramishetti, I. Hazan-Halevy, D. Rosenblum, M. Goldsmith, A. Abrahamc, O. Benjamini, O. Bairey, P. Raanani, A. Nagler, J. Liebermane, and D. Peer. (2016) Harnessing RNAi-based nanomedicines for therapeutic gene silencing in B cell malignancies. Proc. Natl. Acad. Sci. USA 113(1) E16-E22.
2. Dearling, J., Daka, A., Veiga, N., Peer, D., and Packard A. (2016) ImmunoPET of colitis: defining target cell populations and optimizing pharmacokinetics. Inflammatory Bowel Diseases. 22(3):529-538.
3. Ramishetti S., Kedmi R., Goldsmith M., Leonard F., Speague AG., Godin B., Gozin M., Cullis P., Dykxhoorn DM., and Peer D. (2015) Systemic gene silencing in primary T lymphocytes using targeted lipid nanoparticles. ACS Nano.
4. Cohen ZR, Ramishetti S, Peshes-Yaloz N, Goldsmith M, Wohl A, Zibly Z, and Peer D (2015). Localized RNAi therapeutics of chemo-resistant grade IV glioma using hyaluronan-grafted lipid-based nanoparticles. ACS Nano. 9(2), 1581-1591.
5. Singh M.S., Peer D. (2016) RNA nanomedicines: the next generation drugs? Current Opinion in Biotechnology 28-34.



## Research Description

Our lab searches for ways to manipulate cells' functions in order to generate novel strategies for the treatment of inflammatory diseases and cancers. In addition, we develop nanomedicines by designing highly selective targeting moieties and novel nanocarriers. Work at the lab is based on a multidisciplinary approach, which combines immunology, cell and molecular biology, genetics, protein engineering, material sciences, nanotechnology and computational techniques. Our ultimate goal is translating some of our findings into drugs and therapeutics for clinical settings.

We are particularly interested in:

- Developing novel strategies for targeted drug delivery
- Probing and manipulating the immune system with nanomaterials
- Developing non-invasive theranostic systems for inflammatory bowel diseases and blood cancer
- Studying the role of cell cycle regulators during inflammatory bowel diseases and blood cancers
- Investigating novel cancer multidrug resistance inhibitors
- Studying novel approaches to target adult stem cells (hematopoietic, bulge, cancer)
- Harnessing RNAi as a tool for drug discovery and therapeutic applications
- Developing tools to study immuno-nanotoxicity
- Investigating polysaccharides as building blocks for nanotherapeutics

# Prof. Emanuel Peled

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## Research Title

**Nanomaterials and thin films for electrochemical energy storage and conversion**

## Selected Publications

1. H. Mazor, D. Golodnitsky, L. Burstein, A. Gladkich, E. Peled, Electrophoretic deposition of lithium iron phosphate cathode for thin-film 3D-microbatteries, Journal of Power Sources 198, (2012) 264-272.
2. K. Goldshtein, D. Golodnitsky E. Peled, L. Adler-Abramovich, E. Gazit, S. Khatun, P. Stallworth, S. Greenbaum. Effect of peptide nanotubeller on structural and ion-transport properties of solid polymer electrolytes, Solid State Ionics 220 (2012) 39–46.
3. E. Peled. Development and characterization of composite YSZ-PEI electrophoretically deposited membrane for Li-ion battery, J Phys. Chem. B, 117 (2013) (6), 1577–1584.
4. E. Peled, D. Golodnitsky, R. Hadar, H. Mazor, M. Goor and L. Burstein, Challenges and obstacles in the development of sodium-air batteries, Journal of Power Sources 244 (2013) 771-776.

## Research Description

Our research focuses on the development and characterization of novel and improved batteries.

We have developed a molten-sodium/air battery operating at above the melting point of sodium (97.8°C). This battery, in addition to eliminating dendrite formation, can accelerate sluggish cathode reactions and lower cell impedance. We explored the key parameters that affect the performance of the electrodes and their impact on the operation of the molten-Na/air cell in glymes, PYR14TFSI ionic liquid and polyethylene oxide-based electrolytes.

We have developed a very active Oxygen Reduction Reaction (ORR). By using a core-shell nanostructure concept, we were able to reduce the amount of platinum, while at the same time increasing the activity of the ORR catalysts.

We have succeeded in the development of anodes made of silicon nanowires and silicon nanoparticles coated with protective layers. These anodes demonstrate excellent performance that meets the requirements of lithium batteries for portable and electric-vehicle applications.

We investigate the impact of cathode design, type of electrolyte and type of cathode binder on the cathode reactions and on battery performance of lithium-sulfur batteries.

Additionally, we investigate Hybrid Double-Layer Capacitors (HDLCs) that offer at least five times more energy density than water-based Double-Layer Capacitors (DLC).

# Prof. Moshe Portnoy

**Affiliation:** Chemistry

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## Research Title

**Novel catalytic systems for improving selectivity of organic transformations**

## Selected Publications

1. T. Kehat, K. Goren and M. Portnoy. Dendrons on insoluble supports: synthesis and applications. New J. Chem. 31, 2007, 1218-1242.
2. K. Goren and M. Portnoy. Supported N-alkylimidazole-decorated dendrons as heterogeneous catalysts for the Baylis-Hillman reaction. Chem. Commun. 46, 2010, 1965-1967.
3. L. Tuchman-Shukron, S. J. Miller and M. Portnoy. Polymer-supported enantioselective bifunctional catalysts for nitro-Michael addition of ketones and aldehydes. Chem. Eur. J. 18, 2012, 2290-2296.
4. K. Goren, J. Karabline-Kuks, Y. Shiloni, E. Barak-Kulbak, S. J. Miller and M. Portnoy. Multivalency as a key factor for high activity of selective supported organocatalysts for the Baylis-Hillman reaction. Chem. Eur. J. 21, 2015, 1191-1197.
5. J. Karabline-Kuks, A. Fallek and M. Portnoy. Elucidating factors leading to acidolytic degradation of sterically strained oligoether dendrons. Org. Biomol Chem. 12, 2014, 5621-5628.

## Research Description

The efficiency of a chemical transformation is defined by the conversion/consumption of the limiting reactant and the selectivity of formation of the desired product. Combined, these two parameters determine the yield of the process. Thus, low (or unsatisfying) yields can originate from low conversion, low selectivity, or both. However, while slow consumption of the limiting reactant can be counterbalanced by prolonging the reaction time or, in the case of a catalytic reaction, by increasing catalyst loading, impaired selectivity is usually irreparable. Thus, the issue of selectivity in chemical processes is of utmost importance.

Chemical selectivity encompasses several subfields, including: chemo-selectivity, regio-selectivity, stereo-selectivity, site-selectivity and substrate-selectivity. For the past ten years our group has focused on inducing and improving three of these: chemo-selectivity, stereo-selectivity and site-selectivity. To do this, we use new designs of organic catalysts, mainly polymer-supported and dendrimer-based systems.

# Prof. Shachar Richter

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## Research Title

**Bio and molecular electronics**

## Selected Publications

1. Sidelman, Noam, Moshik Cohen, Anke Kolbe, Zeev Zalevsky, Andreas Herrman, and Shachar Richter. Rapid particle patterning in surface deposited micro-droplets of low ionic content via low-voltage electrochemistry and electrokinetics. Scientific Reports 5 (2015).
2. Hendler, Netta, Elad Mentovich, Bálint Korbuly, Tamás Pusztai, László Gránásy, and Shachar Richter. Growth control of peptide-nanotube spherulitic films: experiments and simulations. Nano Research 8, no. 11 (2015): 3630–38.
3. Gordiichuk, Pavlo I, Dolev Rimmerman, Avishek Paul, Daniel A Gautier, Agnieszka Gruszka, Manfred Saller, Jan Willem de Vries, et al., Filling the green gap of a megadalton photosystem I complex by conjugation of organic dyes. Bioconjugate Chemistry (2015).
4. Carmeli, Itai, Moshik Cohen, Omri Heifler, Yigal Lilach, Zeev Zalevsky, Vladimiro Mujica, and Shachar Richter. Spatial modulation of light transmission through a single microcavity by coupling of photosynthetic complex excitations to surface plasmons.Nature Communications (2015).
5. Beilis, Edith, Bogdan Belgorodsky, Ludmila Fadeev, Hagai Cohen, and Shachar Richter. Surface-induced conformational changes in doped bovine serum albumin self-assembled monolayers. Journal of the American Chemical Society 136, no. 17 (2014): 6151–54.

## Research Description

In our group we adopt a bottom-up approach to develop and explore various properties of nanomaterials, self-assembled monolayers and thin films. We start from the molecular level, and use molecular synthesis to form the desired basic structures which, in the next stage, are incorporated into our novel devices. Examples include doped proteins, chiral nanostructures and plasmonic materials.

Our compounds can be formed in self-assembly fashion (the self-assembled monolayers of doped proteins), as thin films (white-emitting coating for white LEDs) or as standalone materials (biodegradable plastics and hydrogels made from renewable materials).

In order to explore the properties of these materials we have developed new types of nano-devices, including nano-vertical transistors and circuits, solar cells and light emitting materials. We have also developed novel nanolithography techniques, some of which are currently undergoing commercialization processes.

Our group includes students, postdocs and engineers from various disciplines - including chemistry, physics, biology and engineering.

# Dr. Yael Roichman

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## Research Title

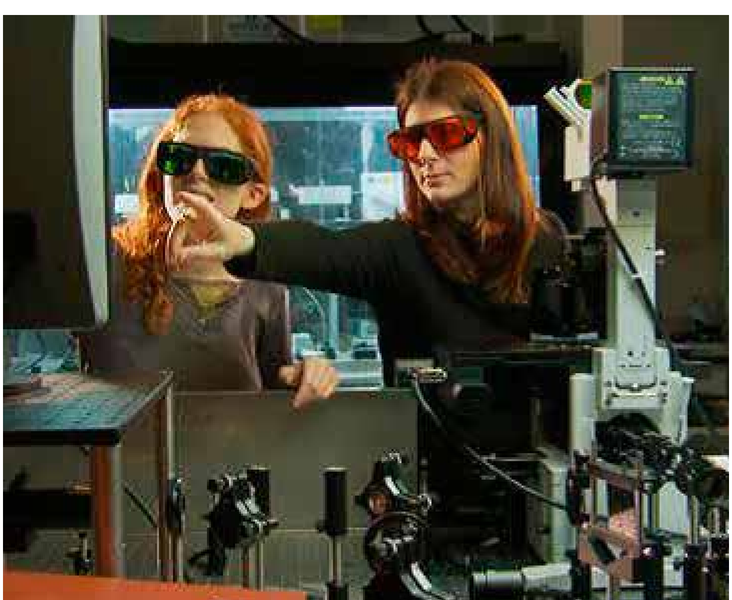
**Soft matter physics using holographic optical tweezers and single particle tracking**

## Selected Publications

1. Holographic optical trapping, D. G. Grier and Y. Roichman, Applied Optics 45, 880-887 (2006).
2. Hydrodynamic pair attractions between driven colloidal particles, Yulia Sokolov, Derek Frydel, David G. Grier, Haim Diamant, and Yael Roichman, Phys. Rev. Lett., 107, 158302, (2011).
3. Extracting the dynamic correlation length of actin networks from microrheology experiments, Adar Sonn-Segev, Anne Bernheim-Groswasser, and Yael Roichman, Soft Matter, 10, 8324-8329 (2014).
4. Scale dependence of mechanics of active gels with increasing motor concentration, Adar Sonn-Segev, Anne Bernheim-Groswasser, and Yael Roichman, Soft Matter 13, 7352 - 7359 (2017).
5. Particle manipulation beyond the diffraction limit using structured super-oscillating light beams, Brijesh Kumar Singh, Harel Nagar, Yael Roichman, and Ady Arie, Light: Science and applications 6, e17050 (2017).

## Research Description

We are interested in studying the underlying physical processes that govern the mechanics, self-organization, dynamics and statistics of complex fluids driven out of thermal equilibrium. Our belief is that by studying many such systems in detail, we will be able to observe emergent shared characteristics, paving the way for a theoretical description. To this end, we use holographic optical tweezers to manipulate and drive microscopic objects, a variety of optical microscopy techniques to image these objects, and image analysis to study their motion and morphology.



# Prof. Gil Rosenman

**Affiliation:** Electrical Engineering
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## Research Title

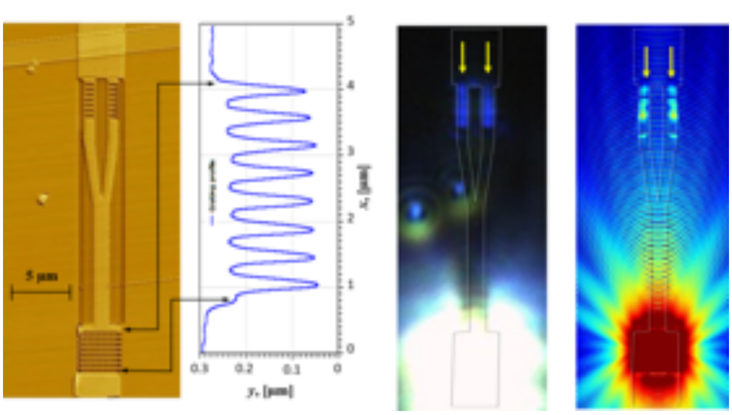
**Physical properties of bioinspired nanomaterials**

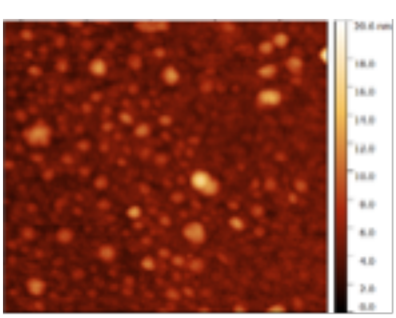
## Selected Publications

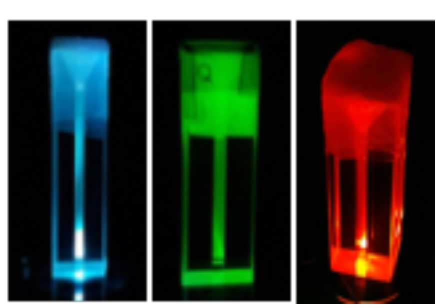
1. S. Semin, A. van Etteger, N. Amdursky, L. Kulyuk, S. Lavrov, A. Sigov, E. Mishina, G. Rosenman, and Th. Rasing, (2015). Strong thermo-induced single and two-photon green luminescence in self-organized peptide microtubes, Small, 11, 1156–1160.
2. A. Handelman, G. Shalev, G. Rosenman, Symmetry of bioinspired peptide nanostructures and their basic physical properties (2015), Israel Journal of Chemistry, 55, 637–644.
3. A. Handelman, N.Kuritz, A. Natan and Gil Rosenman, (2016). Reconstructive phase transition in ultrashort peptide nanostructures and induced visible fluorescence, commissioned Feature Article, Langmuir, 32 (12), 2847–2862.
4. A. Handelman, B. Apter, N.Turko and Gil Rosenman. (2016). Linear and nonlinear optical waveguiding effects in bio-inspired diphenylalanine peptide nanotubes, Acta Biomater, 30, 72–77.
5. A. Handelman, P. Beker, N. Amdursky, G. Rosenman, Physics and engineering of peptide supramolecular nanostructures. Phys Chem Chem Phys. (2012) 14(18):6391-408.

## Research Description

Ultrashort aromatic and aliphatic di- and tripeptide biomolecular nanostructures of different origin and native conformation at the nanoscale are studied by monitoring their basic physical properties during a thermally induced phase transition. We show that this fundamental process, found by us in bioorganic systems, is governed by the thermally activated reconformation of biomolecules, or their spatial reconfiguration. Regardless of the origin of di- and tripeptides and their native architecture, the phase transition takes place by full refolding into another similar, irreversible, and thermodynamically stable fiber-like nanowire morphology. In this new supramolecular arrangement, newly observed bioorganic nanodots, with β-sheet structure and deep reconstruction found at all levels (molecular, electronic, peptide secondary structure, morphological, etc.) generate new physical properties and the appearance of blue/green photoluminescence.







# Prof. Yossi Rosenwaks

**Affiliation:** Electrical Engineering
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## Research Title
**Nanoscale electrical devices**

## Selected Publications

1. Alex Henning, Nandhini Swaminathan, Andrey Godkin, Gil Shalev, Iddo Amit, and Yossi Rosenwaks, Tunable diameter electrostatically-formed nanowire for high sensitivity gas sensing, Nano Research, DOI 10.1007/s 12274-01, (2015).
2. A. Henning, M. Molotskii, N. Swaminathan, Y. Vaknin, A. Godkin, G. Shalev, and Y. Rosenwaks, Electrostatic limit of detection of nanowire-based sensors, Small, DOI: 10.1002/smll.201500566, (2015).
3. G. Segev, I. Amit, A. Godkin, A. Henning, and Y. Rosenwaks, Multiple state electrostatically formed nanowire transistors, IEEE Electron Device Lett. DOI: 10.1109/LED.2015.2434793, (2015).
4. I. Amit, N. Jeon, L. J. Lauhon, and Y. Rosenwaks, The impact of dopant compensation on graded p-n junctions in Si nanowires, ACS Applied Materials & Interfaces, 8 (1), pp 128–134, (2016).
5. S. U. Nanayakkara, G. Cohen, C. S. Jiang, M. J. Romero, K. Maturova, M. Al-Jassim, J.van de Lagemaat, Y. Rosenwaks, and J. M. Luther, Built-in potential and charge distribution within single heterostructured nanorods measured by scanning Kelvin probe microscopy, Nanoletters, 13, 1278-1284 (2013).

## Research Description

Prof. Rosenwaks leads a research group of 10 graduate students and scientists, and his current research interests include: nanoscale electrical measurements using mainly Kelvin probe force microscopy, nanowire transistors and sensors, charge carrier dynamics and transport in semiconductors, and Kelvin probe microscopy of 2D materials.

Current projects in the lab include:

- Atomic resolution UHV AFM and KPFM measurements

Semiconductor and organic nano-structure characterization using ambient and Ultra High Vacuum (UHV) AFM and Kelvin Probe Force Microscopy (KPFM), Low Temperature (LT) UHV KPFM, SEM.

- Biochemical field-effect transistor

The overall objective of the research is to understand the mechanism of biosensing of FET-based biosensors. An additional goal is to untangle the question of the electrostatic effect of polar molecular layers: field effects, polar effects or maybe both. The goals will be achieved while demonstrating the advantages of using the KPFM method to directly measure the changes in channel band bending.

- Silicon nanowires

Our research focuses on determining the doping profiles of Vapour Liquid Solid (VLS) grown silicon Nanowires (NW) by using KPFM measurments in conjunction with numerical solutions. We are also focusing on understanding the electrical characteristics of NW-based devices.

- Photovoltaic cells

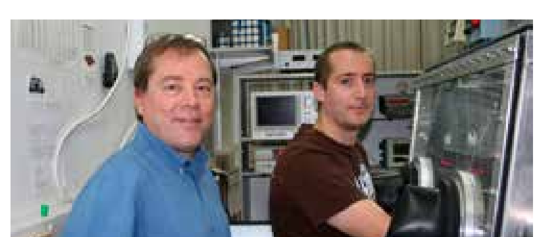
The study proposes to develop a novel photovoltaic cell converting sunlight to electricity at higher efficiency relative to existing cells, and with improved flexibility for integration in modules, both one-sun and concentrating.

- KPFM image deconvolution algorithm

In Kelvin Probe Force Microscopy (KPFM) the long-range electrostatic forces between the measuring tip and the surface of the measured sample create an averaging effect of the features in the sample, which is expressed in a convolution between the tip's Point Spread Function (PSF) and the potential image of the sample. This effect prevents quantitative measurement of nanostructures. The objective is to develop a deconvolution algorithm that restores the actual sample work function, and reconstructs images measured even on rough surfaces. This will allow us to extract the actual surface potential from any KPFM measurement in general, and nanostructures in particular.

- Pentacene Organic Thin-Film Transistors (OTFT)

Investigation of the electrical properties in the Grain Boundaries (GB), using KPFM and other methods to shed light on the details of microscopic intermolecular-transport dynamics, especially trapping and detrapping mechanisms in the GB.



# Prof. Ronit Sagi-Eisenbrg

**Affiliation:** Medicine
**Email:** histol3@post.tau.ac.il

## Research Title

**Nanoscale functional genomics and proteomics analyses of mast cell activation**

## Selected Publications

1. Efergan A, Azouz NP, Klein O, Noguchi K, Rothenberg ME, Fukuda M, Sagi-Eisenberg R., Rab12 regulates retrograde transport of mast cell secretory granules by interacting with the rilp-dynein complex. J Immunol. (2016), 196:1091-101.
2. Rudich N, Dekel O, Sagi-Eisenberg R., Downregulation of the A3 adenosine receptor in human mast cells upregulates mediators of angiogenesis and remodeling. Mol Immunol. (2015);65:25-33.
3. Azouz, N.P., Zur, N., Efergan, A., Ohbayashi, N., Fukuda, M., Amihai, D., Hammel, I., Rothenberg, ME and Sagi-Eisenberg, R. Rab5 is a novel regulator of mast cell secretory granules: impact on size, cargo and exocytosis. J Immunol. 192:4043-53 (2014)
4. Bar-Gill-Benado, A., Efergan, A., Seger, R., Fukuda, M., and Sagi-Eisenberg R. The extra-cellular signal regulated kinases ERK1 and ERK2 segregate displaying distinct spatiotemporal characteristics in activated mast cells. Biochim Biophys Acta. 1833, 2070-2082, (2013).
5. Azouz NP, Matsui, T., Fukuda, M. and Sagi-Eisenberg, R. Decoding the regulation of mast cell exocytosis by networks of Rab GTPases. J Immunol. 189, 2169-2180. (2012).

## Research Description

Our primary interest is the molecular basis of allergic and allergy-related diseases, including skin allergy and asthma. Specifically, we explore the mechanisms underlying release of allergic (i.e. histamine) and inflammatory (i.e. cytokine) mediators from activated mast cells.

Our research focuses on deciphering the signaling networks that link mast cell activation with mediator release, and characterization of genes that could serve as cellular targets for the future development of anti-allergic and anti-asthma drugs. To this end, we combine functional genomics and phenotype-driven screens of mast cells, activated by multiple stimuli, in order to recapitulate human pathophysiologic conditions. Research methods used include: confocal microscopy in live and fixed cells; gene cloning; quantitative RT-PCR; pull-down-assays; mass spectrometry; and bioinformatics.

Current projects in the lab include:

- Exploring the genetic connections between the size of the mast cell secretory granules and mastocytosis.
- Mast cells and cancer- the good, the bad and the ugly. Decoding the Rab networks that control mast cell function.

# Prof. Ronit Satchi-Fainaro

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## Research Title

**Identifying molecular signatures of tumor dormancy as a basis for the rational design of precision nanomedicines**

## Selected Publications

1. Markovsky E, Eldar-Boock A, Ben-Shushan D, Baabur-Cohen H, Yeini E, Many A, Aviel-Ronen S, Barshack I, Satchi-Fainaro R, Targeting NCAM-expressing neuroblastoma with polymeric precision nanomedicine, Journal of Controlled Release, 249:162-172 (2017).
2. Hananya N, Green O, Blau R, Satchi-Fainaro R*. Shabat D*, A highly-efficient chemiluminescence probe for detection of singlet oxygen in living cells. Angew Chem Int Ed Engl. 138(40):13438-13446 (2017).
3. Markovsky E*, Vax E*, Ben-Shushan D, Eldar-Boock A, Shukrun R, Yeini E, Barshack I, Caspi R, Harari-Steinberg O, Pode-Shakked N, Dekel B, Satchi-Fainaro R, Wilms' tumor NCAM-expressing cancer stem cells as potential therapeutic target for polymeric nanome. Mol Cancer Ther. (2017) Nov;16(11):2462-2472.
4. Ferguson EL, Scomparin A, Hailu H, Satchi-Fainaro R. HPMA copolymer-phospholipase C and dextrin-phospholipase A2 as model triggers for Polymer Enzyme Liposome Therapy (PELT). J Drug Target (2017). Jul 21:1-33.
5. Ferber S*, Tiram G*, Sousa-Herves A*, Eldar-Boock A, Krivitsky A, Ofek P, Scomparin A, Yeini E, Vossen LI, Licha K, Grossman R, Ram Z, Henkin J, Ruppin E, Auslander N, Haag R, Calderón M and Satchi-Fainaro R, Co-targeting the tumor endothelium and P-selectin-expressing glioblastoma cells leads to a remarkable therapeutic outcome. Elife. (2017) Oct 4;6.

*Co-corresponding authors.

## Research Description

Tumor progression is dependent on a number of sequential steps. At the earliest stages, these involve initial tumor-vascular interactions and recruitment of blood vessels, as well as the establishment of the tumor cells' interactions with their surrounding microenvironment and its various immune, endothelial and connective cellular and extra-cellular components. Failure of a microscopic tumor, either primary, recurrent or metastatic, to complete one or more of these early stages, may delay the cancer's clinical manifestation. In fact, understanding these early processes may help us interrupt the cancer's progress, thereby preventing its occurrence, and particularly its recurrence.

With relapse – arising from micrometastasis, dormant tumors or minimal residual disease - responsible for the majority of cancer deaths, the understanding of cancer dormancy and the stages of its awakening is most critical for early detection and treatment. And yet, surprisingly, this is one of the most neglected areas in cancer research, and its biological mechanisms are mostly unknown.

To tackle this challenge, we created several patient-derived cancer models, mimicking 3 pairs of malignancies: dormant versus fast-growing, primary versus metastatic and drug-sensitive versus drug-resistant. This was done with cutting-edge techniques of patient-derived xenografts, 3D printing and genetically-modified mouse models. The 3 models were then used to investigate the molecular changes in tumor-host interactions that govern the escape from dormancy, and contribute to tumor progression. Ultimately, our study led to the discovery of novel drug targets, and provided important tools for the design of novel nano-sized cancer theranostics (therapeutics and diagnostics). Our libraries of precision nanomedicines are synthesized as highly controlled micellar, nanogels, coiled or globular particulated supramolecular structures, consisting of linear, hyperbranched or dendritic polymers, based on polyglutamic acid (PGA), polyethyleneglycol (PEG), poly(N-(2-hydroxypropyl) methacrylamide) (HPMA) copolymer, polyglycerol, poly(lactic-coglycolic acid) (PLGA) and hybrid systems. We hypothesize that the knowledge acquired from this multidisciplinary research strategy will revolutionize the way cancer is diagnosed and treated.

# Prof. Jacob Scheuer

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## Research Title

**Nano-photonic devices and applications**

## Selected Publications

1. G. Kaplan, K. Aydin and J. Scheuer, Dynamically controlled plasmonic nano-antenna phased array utilizing vanadium dioxide, Opt. Mater. Express 5, 2513-2524 (2015). (Commissioned)
2. E. Ben Bassat and J. Scheuer, Optimal design of radial Bragg cavities and lasers, Opt. Lett. 40, 3069-3072 (2015).
3. M. Eitan, Z. Iluz, Y. Yifat, A. Boag, Y. Hanein, and J. Scheuer, Degeneracy breaking of Wood's Anomaly for enhanced refractive index sensing, ACS Photon. 2, 615–621 (2015).
4. D. Bar-Lev, A. Arie, J. Scheuer, and I. Epstein, Efficient excitation and control of arbitrary surface plasmon polariton beams using one-dimensional metallic gratings, J. Opt. Soc. Am. B 32, 923-932 (2015).
5. J. Scheuer and Y. Yifat, Metasurfaces make it practical, Nature Nanotech. 10, 296-298 (2015).

## Research Description

Nano-Photonics deals with the interaction of light and matter at the nanoscale. This research field is of fundamental scientific importance, while also providing a main route to novel technologies and applications - such as sensing, solar energy harvesting, telecommunications and optical computing.

Specifically in our lab we focus on the development of nano-antennas for optical frequencies, which have applications in many different areas: solar energy harvesting, controlled self-assembly and beam shaping, nano semiconductor lasers for sensing and telecommunications, and secure communications using fiber lasers and polymer optics.

# Dr. Tal Schwartz

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## Research Title

**Optical properties of organic molecules coupled to optical devices**

## Selected Publications

1. K. Akulov, R. Simkovitch, Y. Erez, R. Gepshtein, T. Schwartz and D. Huppert, Acid effect on photobase properties of curcumin. J. Phys. Chem. A 118, 2470 (2014).
2. R. Simkovitch, K. Akulov, S. Shomer, M. E. Roth, D. Shabat, T. Schwartz and D. Huppert, Comprehensive study of ultrafast excited-state proton transfer in water and D2O providing the missing RO-…H+ ion-pair fingerprint. J. Phys. Chem. A 118, 4425 (2014).
3. Y. Erez, R. Simkovitch, K. Akulov, R. Gepshtein, T. Schwartz and D. Huppert, Two Roads Converged in a Yellow Dye: Unusual spectral broadening in the emission of Auramine-O possibly caused by low-friction intramolecular rotation. J. Phys. Chem. C 118, 27063 (2014).
4. Canaguier-Durand, A., Devaux, E., George, J., Pang, Y., Hutchison, J., Schwartz, T., Genet, C., Wilhelms, N., Lehn, J. M., Ebbesen, T, Thermodynamics of molecules strongly coupled to the vacuum field. Ang. Chem. Int. Ed 52, 10533 (2014).
5. T. Schwartz, J.A. Hutchison, J. Leonard, C. Genet, S. Haacke and T.W. Ebbesen, Polariton dynamics under strong light-molecule coupling. ChemPhysChem, 14, 125-131 (2013).

## Research Description

In nature, light and matter interact constantly, with photons absorbed or emitted, inducing chemical reactions and driving the transport of charges. When such interactions occur inside a wavelength-scale region, confined by a photonic nanostructure, they can change dramatically, giving rise to new and exciting effects.

In our research we explore artificial structures with which we may create complex materials with new properties, and control the interaction of light and matter. We focus on several aspects of this theme, which lies at the meeting point of Chemistry, Quantum Physics, Optics and Material Science:

- Strong interaction of molecules with light - We investigate the optical properties of organic molecules (dyes) coupled with optical devices, aiming to understand quantum many-body processes in such hybrid systems, and to control these interactions. Gaining such control is important for photochemistry, light-harvesting and organic light-emitting devices.
- Optical properties of metallic nanoparticle clusters - A nanometer-size gold particle has a very distinct color, completely different from the color of bulk gold. The reason is that when we shape a metal at the nanometric scale, it supports localized plasmon modes that depend on features like geometry and size. In our research we explore how such nanoparticles assemble into well-defined clusters, in order to produce composite materials with new optical properties.

# Prof. Daniel Segal

**Affiliation:** Life Sciences
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## Research Title

**Determinants of protein misfolding and self-assembly in amyloid diseases, and development of novel inhibitors as candidate therapeutics**

## Selected Publications

1. Shaltiel-Karyo, R., Davidi, D., Menuchin, Y., Frenkel-Pinter, M., Marcus-Kalish, M., Ringo, J., Gazit, E. and Segal, D.(2012). A novel, sensitive assay for behavioral defects in Parkinson's disease model Drosophila. Parkinson's Disease (697564, Epub 2012 Jul 25).
2. Shaltiel-Karyo, R., Davidi, D., Frenkel-Pinter, M., Ovadia, M., Segal, D., and Gazit, E. (2012). Differential inhibition of alpha-synuclein oligomeric and fibrillar assembly by cinnamon extract. Biochimica et Biophysica Acta 1820: 1628–1635.
3. Herzog, G., Joerger, A.C., Shmueli, M., Fersht, A.R., Gazit, E. and Segal, D. (2012) Evaluating Drosophila p53 as a model system for studying cancer mutations. J Biol Chem, 287(53):44330-7.
4. Scherzer-Attali, R., Convertino, M., Pellarin, R., Gazit , E., Segal, D., and Caflisch, A. (2013). Methylations of tryptophan modified naphtoquinone affect its inhibitory potential towards A-beta aggregation. J. Phys Chem B 117:1780-9.
5. Shmueli, M.D., Schnaider, L., Rosenblum, D., Herzog, G., Gazit, E., and Segal, D. (2013). Structural insights into the folding defects of oncogenic pVHL lead to correction of its function in vitro. PLoS ONE, 8: e66333.

## Research Description

'Conformational diseases' are diseases caused by misfolding of a protein, often as a result of a missense mutation that does not necessarily disrupt the active site of the protein. As a result, the protein may lose its function, and often the misfolded monomers self-assemble to form cytotoxic aggregates. In some cases such misfolding can be reversible under experimental conditions. Thus, drugs that cause refolding of the misfolded protein may restore its function and prevent its harmful aggregation.

We study the structural causes of protein misfolding in conditions ranging from neurodegenerative diseases to certain cancers, and search for ways to refold them. Our research methods include: In-vitro and bacterial assays of protein folding and aggregation (in collaboration with Prof. Ehud Gazit, Biotechnology Dept.), cytotoxicity assays in cell culture, genetics and molecular biology of transgenics (Drosophila, mice), immunohistochemistry, behavioral and cognitive assays (mouse work - in collaboration with Dr. Dan Frenkel, Neurobiology Dept.). Main projects in the lab include:

- In-vivo development and screening of novel small molecules to address a range of diseases: amyloid-beta and tau inhibitors for Alzheimer's disease; alpha-synuclein inhibitors for Parkinson's disease; and TDP-43 inhibitors for ALS
- Developing and screening natural plant compounds, as amyloid-beta and tau inhibitors for Alzheimer's disease
- Examining the mechanism of TDP-43 spreading in ALS
- Examining the role of protein glycosylation in the aging and neurodegenerative brain
- Studying the misfolding of the tumor suppressor proteins p53 and VHL, and developing small molecules for restoring their folding and function.

# Prof. Eran Sela

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## Research Title

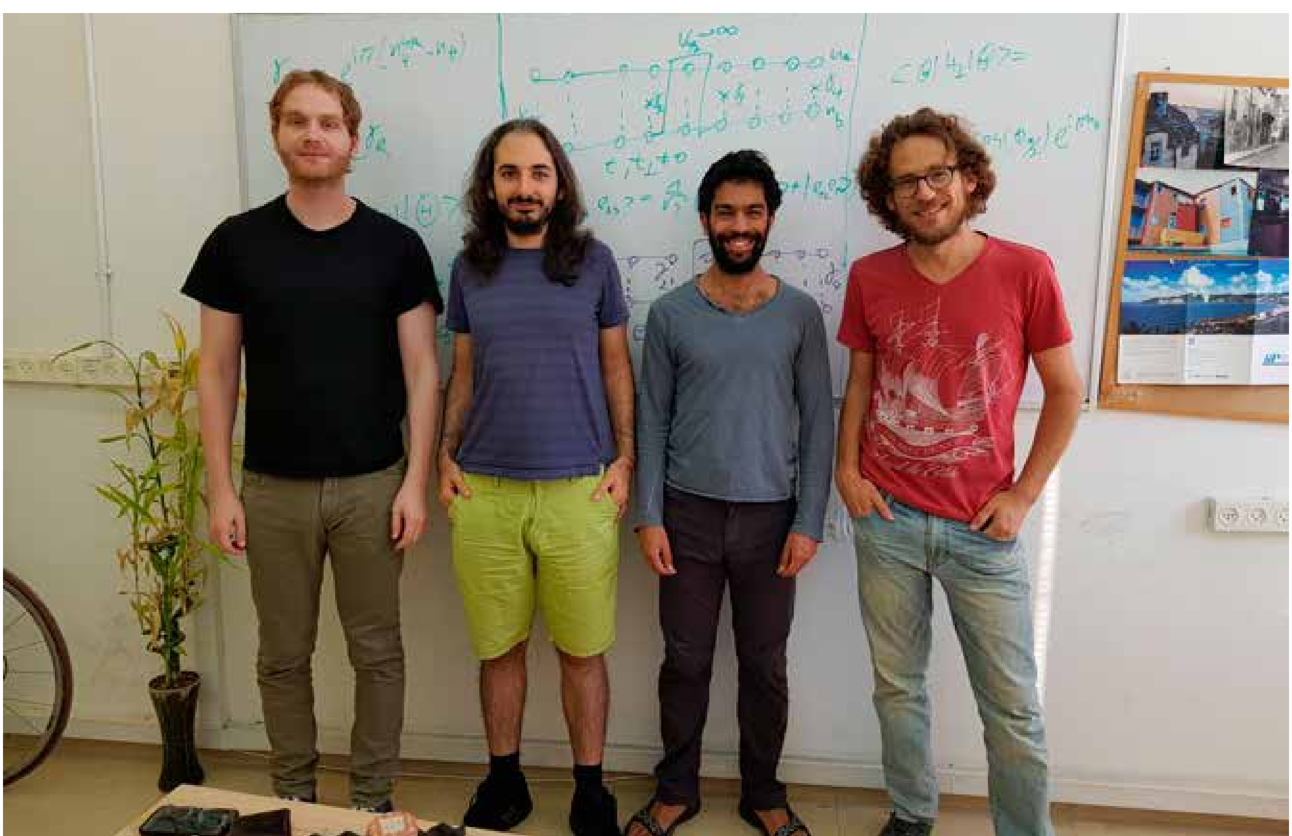
**Interaction quantum effects in low dimensional many-body systems**

## Selected Publications

1. E Sela, A Altland, A Rosch, Majorana fermions in strongly interacting helical liquids, Physical Review B 84 (8), 085114 (2011).
2. Eran Sela, Yuval Oreg, Felix von Oppen, Jens Koch, Fractional shot noise in the Kondo regime, Physical review letters 97 (8), 086601, (2006).
3. Yuval Oreg, Eran Sela, Ady Stern, Fractional helical liquids in quantum wires, Physical Review B 89 (11), 115402 (2014).
4. LA Landau, S Plugge, E Sela, A Altland, SM Albrecht, R Egger, Towards realistic implementations of a Majorana surface code, Physical review letters 116 (5), 050501 (2016).

## Research Description

We conduct theoretical studies in the field of strongly correlated electron quantum systems in condensed matter. In such systems, the particles (electrons/photons/atoms) cannot be considered independently. Rather, their behavior at low temperatures is governed by collective many-body physics. The superimposed wavy nature of these particles may lead to exotic phenomena, and problems addressed by this field are exceptionally rich and complex. Moreover, basic research of many-body physics in confined systems is highly pertinent to the fast-developing technology of devices at the nanometer scale, such as small electronic devices based on photonic cavities or cold atom systems. Our theoretical studies apply advanced field-theory approaches, such as path integrals, 'bosonization' and the renormalization group.



# Prof. Yosi Shacham-Diamand

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## Research Title

**Interconnect micro and nano fabrication**

## Selected Publications

1. Yoetz-Kopelman, T., Dror, Y., Shacham-Diamand, Y., & Freeman, A. (2016). "Cells-on-beads": A novel immobilization approach for the construction of whole-cell amperometric biosensors. Sensors and Actuators B: Chemical.
2. Ram, Y., Yoetz-Kopelman, T., Dror, Y., Freeman, A., & Shacham-Diamand, Y. (2016). Impact of molecular surface charge on biosensing by electrochemical impedance spectroscopy. Electrochimica Acta.
3. Hemed, N. M., Convertino, A., & Shacham-Diamand, Y. (2016). Investigation of functionalized silicon nanowires by self-assembled monolayer. Applied Surface Science, 357,231-236 (2016).
4. Yoetz-Kopelman, T., Porat-Ophir, C., Shacham-Diamand, Y., & Freeman, A. (2016). Whole-cell amperometric biosensor for screening of cytochrome P450 inhibitors. Sensors and Actuators B: Chemical, 223, 392-399.
5. Feiner, R., Engel, L., Fleischer, S., Malki, M., Gal, I., Shapira, A., Shacham-Diamand Y. & Dvir, T., (2016). Engineered hybrid cardiac patches with multifunctional electronics for online monitoring and regulation of tissue function. Nature Materials.

## Research Description

Cu interconnect requires barrier layers to prevent Cu diffusion into the dielectrics and the Si substrate. Cu lines also require capping layers to prevent oxidation and improve reliability, by reducing Cu surface electromigration - mostly at the top interface, where the Cu was exposed to chemical mechanical polishing during the 'Dual Damascene' fully embedded metal positive patterning process. Electroless nickel and cobalt alloys were found to be very useful as barrier and capping layers for Cu metallization. The most useful barrier and capping layers were made of alloys of cobalt and nickel with refractory metals (tungsten, molybdenum or rhenium), and also with phosphorus or boron.

The coupling of living cells, serving as sensor elements, with microelectronic devices, provides novel opportunities for biosensors performing as stable, sensitive, specific and accurate electronic devices. Electroless Deposition methods, in which metal cations are chemically reduced by a reducing agent into a deposited metallic film, may provide a new and effective tool for the coupling of biological activities and electronic circuits. Electrical characteristics (conductivity) and structure preservation are achieved by coating the structure with a thin metal film.

The main goal of our research is to study the new concept of integration of metallized whole cells with electronically interfacing biosensors. In order to miniaturize the biosensors we want to work with a single cell or a small number of cells located within a small area on a chip. To achieve this, we must be able to control the location of the cell on the electrode, and to provide electrical contact between cell and electrode. We hypothesize that by using cells metallized by electroless deposition we can achieve both goals.

# Prof. Natan Shaked

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## Research Title

**Biomedical optical microscopy, nanoscopy and interferometry**

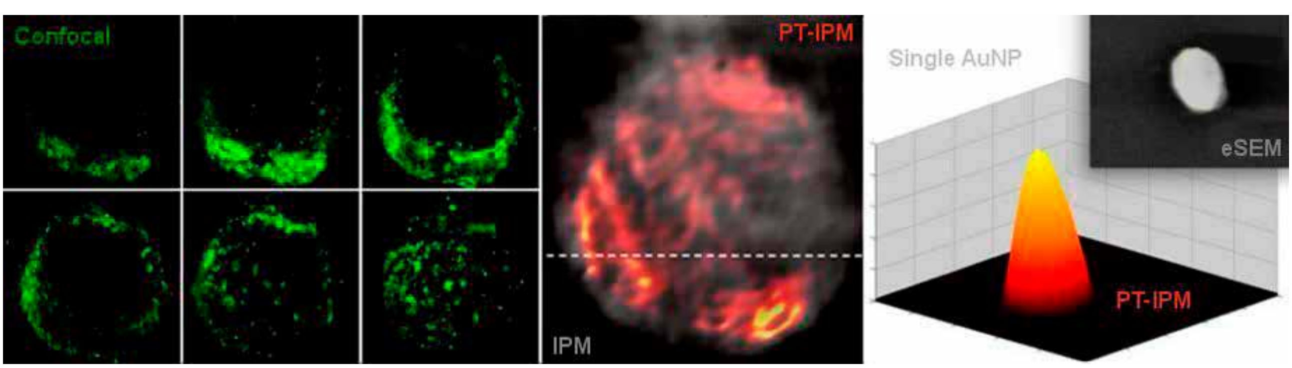
## Selected Publications

1. P. Girshovitz and N. T. Shaked, Doubling the field of view in off-axis low-coherence interferometric imaging, Nature – Light: Science and Applications (Nature LSA), Vol. 3, e151, pp. 1-9, 2014.
2. P. Girshovitz and N. T. Shaked, Compact and portable low-coherence interferometer with off-axis geometry for quantitative phase microscopy and nanoscopy, Optics Express, Vol. 21, Issue 5, pp. 5701-5714, 2013.
3. M. Habaza, B. Gilboa, Y. Roichman, and N. T. Shaked, Tomographic phase microscopy with 180° rotation of live cells in suspension by holographic optical tweezers, Optics Letters, Vol. 40, Issue 8, pp. 1881-1884, 2015.
4. O. Blum and N. T. Shaked, Prediction of photothermal phase signatures from arbitrary plasmonic nanoparticles and experimental verification, Nature – Light: Science and Applications (Nature LSA), Vol. 4, e322, pp. 1-8, 2015.
5. N. Turko, I. Barnea, O. Blum, R. Korenstein, and N. T. Shaked, Detection and controlled depletion of cancer cells using photothermal phase microscopy, Journal of Biophotonics, Vol. 8, Issue 9, pp. 755-763, 2015.

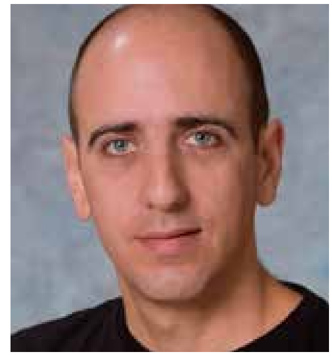
## Research Description

We are interested in the development of interferometric imaging methods for nano-profiling of thin elements, such as live biological cells in vitro, lithography processes and semiconductor wafers.

Specifically, we develop interferometric and tomographic phase microscopy methods that can operate outside of the optical lab, in instable environments. By using compact, low-coherence, common-path, off-axis interferometric modules, we obtain 3-D imaging of live biological cells without external labeling, and record the optical path delay of light passing through the sample with sub-nanometer accuracy. Furthermore, since these interferometric methods are very sensitive to local refractive-index changes, we develop plasmonic nanoparticles, which induce local heat changes due to photothermal excitation, as new contrast agents in live cells.



# Prof. Yair Shokef



**Affiliation:** Mechanical Engineering
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## Research Title

**Nonequilibrium statistical mechanics of soft matter**

## Selected Publications

1. Y. Han, Y. Shokef, A.M. Alsayed, P. Yunker, T.C. Lubensky, and A.G. Yodh, Geometric frustration in buckled colloidal monolayers, Nature 456, 898 (2008).
2. E. Ben-Isaac, Y.K. Park, G. Popescu, F.L.H. Brown, N.S. Gov, and Y. Shokef, Effective temperature of red blood cell membrane fluctuations, Physical Review Letters 106, 238103 (2011).
3. Y. Shokef and S.A. Safran, Scaling laws for the response of nonlinear elastic media with implications for cell mechanics, Physical Review Letters 108, 178103 (2012).
4. C. Coulais, E. Teomy, K. de Reus, Y. Shokef, and M. van Hecke, Combinatorial design of textured mechanical metamaterials, Nature 535, 529 (2016).
5. F. Leoni and Y. Shokef, Attraction controls the inversion of order by disorder in buckled colloidal monolayers, Physical Review Letters 118, 218002 (2017).

## Research Description

Our current research efforts focus on two main issues: jammed matter and active matter. The first involves using lattice-based models to study disordered soft materials, such as powders, foams, colloids, and glasses - the dynamics of which are all extremely slow and cooperative. Some of these models jam and remain disordered, due to geometric frustration - namely the inability of a system to simultaneously satisfy all of its local constraints, thus making it difficult for it to reach a global optimum which minimizes the relevant free energy. Other models, studied both analytically and numerically, display kinetically constrained dynamics. Here the geometry is implemented effectively by directly defining which dynamical moves are allowed, and which are forbidden - in ways that may generate jamming similar to that found in more complicated models.

Our second line of research involves the study of fluctuations generated in biological systems due to the presence of molecular motors within them. These motors consume chemical energy and generate mechanical forces that drive the system out of thermodynamic equilibrium. Moreover, biological materials have a very nonlinear mechanical response, and therefore the macroscopic mechanical properties of biological systems are very different from those of passive materials. Our activity along this avenue includes the use of stochastic models for the dynamics, in conjunction with geometrical descriptions of the nonlinear, finite-deformation elasticity of biological materials.

# Dr. Noam Shomron

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## Research Title

**Genomics of human diseases**

## Selected Publications

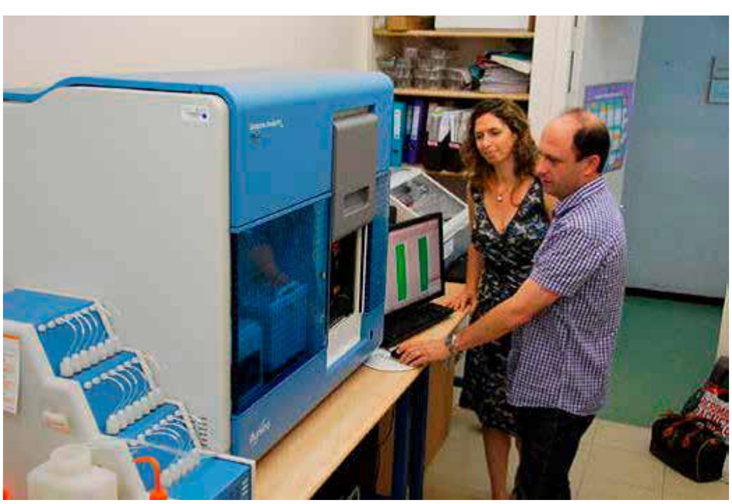
1. Isakov O, Perrone M, Shomron N. Exome sequencing analysis: a guide to disease variant detection. Methods Mol Biol. 2013;1038:137-58.
2. Gilam A, Edry L, Mamluk-Morag E, Bar-Ilan D, Avivi C, Golan D, Laitman Y, Barshack I, Friedman E, Shomron N. Involvement of IGF-1R regulation by miR-515-5p modifies breast cancer risk among BRCA1 carriers. Breast Cancer Res Treat. 2013 Apr;138(3):753-60.
3. Mor E, Kano S, Colantuoni C, Sawa A, Navon R, Shomron N. MicroRNA-382 expression is elevated in the olfactory neuroepithelium of schizophrenia patients. Neurobiol Dis. 2013 Jul;55:1-10.
4. Shomron N. Genetics research: jumping into the deep end of the pool. Genet Res (Camb). 2013 Feb;95(1):1-3.
5. Isakov O, Ronen R, Kovarsky J, Gabay A, Gan I, Modai S, Shomron N. Novel insight into the non-coding repertoire through deep sequencing analysis. NucleicAcids Res. 2012 Jun;40(11):e86.

## Research Description

The Shomron research team focuses on the analysis of genomics, aimed at understanding human diseases. Combining high-throughput methods and bioinformatics, our team explores gene regulators, such as microRNAs, in order to reach a global systems perspective on the mechanistic roles small RNA play during disease development.

Among our projects: Identifying microRNAs located at the intersection of several oncogenes; Controlling metastatic breast cancer via nanoparticles releasing microRNAs; Revealing the influence of microRNAs on pharmacogenomics and personalized medicine; Exposing pathogens in human tissues based on deep sequencing of small RNA molecules.

Overall, our team pursues research that aims to deepen our understanding of the development of diseases, in order to generate a significant impact through translating ideas into clinical reality.



# Dr. Amit Sitt

**Affiliation:** Chemistry
**Email:** aysitt@gmail.com

## Research Title

**Programmable and interactive materials**

## Selected Publications

1. Sitt A, Soukupova J, Miller D, Verdi D, Zboril R, Hess H, Lahann J. Microscale rockets and picoliter containers engineered from electrospun polymeric microtubes Small. 2016 Mar;12(11):1432-9. doi: 10.1002/smll.201503467.
2. Sitt A, Hess H., Directed transport by surface chemical potential gradients for enhancing analyte collection in nanoscale sensors, Nano Lett. 2015 May 13;15(5):3341-50. doi: 10.1021/acs.nanolett.5b00595
3. Zhang C, Sitt A, Koo HJ, Waynant KV, Hess H, Pate BD, Braun PV. Autonomic molecular transport by polymer films containing programmed chemical potential gradients, J. Am Chem Soc. 2015 Apr 22;137(15):5066-73. doi: 10.1021/jacs.5b00240.
4. Jia G, Sitt A, Hitin GB, Hadar I, Bekenstein Y, Amit Y, Popov I, Banin U., Couples of colloidal semiconductor nanorods formed by self-limited assembly, Nat Mater. 2014 Mar;13(3):301-7.
5. Banin U, Sitt A., Colloidal self-assembly: Superparticles get complex, Nat Mater. 2012 Dec;11(12):1009-11. doi: 10.1038/nmat3509.

## Research Description

Programmable materials are materials whose properties, behavior and functionality are directly dictated by the chemical information written and programmed within them. The prime example of such materials are proteins, in which the programming of the amino acid sequence (the primary structure) directly determines the three-dimensional structure (the tertiary structure). Our group studies chemically programmable materials that contain a sequence of commands (information) for performing a specific task or function coded in their chemical structure. In particular, we are interested in synthesis and fabrication of polymer fibers that can hold chemical and physical information, and study how this information can be used for folding these one-dimensional fibers into three-dimensional structures, and how a specific design can lead to selective binding and to self-assembly. Using tools from Thermodynamics and from Information Theory, we explore the underlying principles that determine the behavior of programmable materials. We also study the use of such materials for fabrication of microelectromechanical systems (MEMs) and for medical applications, including tissue engineering and smart drug release mechanisms.

In our lab, we employ a variety of fabrication techniques including lithography, electro-hydrodynamic co-jetting and deposition methods. In addition, we make use of an array of microscopy and spectroscopy techniques for characterization and manipulation of these systems, and utilize a variety of computational and theoretical tools for modeling, analyzing and understanding the characteristics of such materials.

# Prof. Inna Slutsky

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## Research Title

**Neuronal plasticty**

## Selected Publications

1. Gazit, N., Vertkin, I., Shapira, I., Helm, M., Slomowitz, E., Sheiba, M., Mor, Y., Rizzoli, S., and Slutsky, I. (2016) IGF-1 receptor differentially regulates spontaneous and evoked transmission via mitochondria at hippocampal synapses, Neuron 89, 583-597.
2. Frere, S. and Slutsky, I. (2016) Targeting PTEN interactions for Alzheimer's disease, Nature Neuroscience 19, 416-418.
3. Vertkin, I., Styr, B., Slomowitz, E., Ofir, N., Shapira, I., Berner, D., Fedorova, T., Laviv, T., Barak-Broner, N., Greitzer-Antes, D., Gassmann, M., Bettler, B., Lotan, I., and Slutsky, I. (2015) GABAB receptor deficiency causes failure of neuronal homeostasis in hippocampal networks, Proc Natl Acad Sci U S A 112, E3291-3299.
4. Slomowitz, E., Styr, B., Vertkin, I., Milshtein-Parush, H., Nelken, I., Slutsky, M., Slutsky, I. (2015). Interplay between population firing stability and single neuron dynamics in hippocampal networks. Elife 4.

## Research Description

The long-term goal of our study is to understand cellular, molecular and network-wide mechanisms underlying the transition from normal brain physiology to Alzheimer's disease (AD) pathology.

Utilizing an integrated system that combines FRET spectroscopy / 2photon-FLIM, high-resolution optical imaging, electrophysiology, molecular biology and biochemistry, we explore the casual relationships between ongoing neuronal activity, structural rearrangements within synaptic signaling complexes and plasticity of individual neurons, and the whole neural network. This integrated system has enabled us to identify new principles and novel molecular targets that critically influence synaptic and memory functions, initiating AD-associated synaptic dysfunctions. Specifically, we have identified hyperactivity of excitatory hippocampal synapses as a primary mechanism initiating synaptic dysfunctions, and have also found the mechanism underlying these synaptic changes.

We believe that the integrated system we have developed to measure structure-function relationships at the single synapse level may contribute to a better understanding of the initiation of AD-related neuronal and synaptic dysfunctions, ultimately leading to a new therapeutic approach by reversing hippocampal hyperactivity in Alzheimer's patients.

# Prof. David Sprinzak

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## Research Title

**Systems developmental biology**

## Selected Publications

1. Loza O, Heemskerk I, Gordon-Bar N, Amir-Zilberstein L, Jung Y, Sprinzak D., A synthetic planar cell polarity system reveals localized feedback on Fat4-Ds1 complexes. Elife. 2017 Aug 18.
2. Shaya O, Binshtok U, Hersch M, Rivkin D, Weinreb S, Amir-Zilberstein L, Khamaisi B, Oppenheim O, Desai RA, Goodyear RJ, Richardson GP, Chen CS, Sprinzak D., Cell-cell contact area affects notch signaling and notch-dependent patterning. , Dev Cell. 2017 Mar
3. Khait I, Orsher Y, Golan O, Binshtok U, Gordon-Bar N, Amir-Zilberstein L, Sprinzak D. Quantitative analysis of Delta-like 1 membrane dynamics elucidates the role of contact geometry on notch signaling. Cell Rep. 2015 Dec 30.
4. D. Sprinzak, A. Lakhanpal, L. LeBon, L. A. Santat, M. E. Fontes, G. A. Anderson, J. Garcia-Ojalvo, M. B. Elowitz, Cis interactions between Notch and Delta generate mutually exclusive signaling states, Nature. 2010 May 6;465(729)
5. Juxtacrine signaling is inherently noisy, Biophys. J. (2014) vol. 107, Issue 10, Pages 2417–2424.

## Research Description

The development of a multicellular organism is a truly fantastic process. How genetically identical cells differentiate into distinct cell types in an accurate and reproducible manner remains one of the most important questions in biology.

The long-term goal of the lab is to elucidate the design principles of complex developmental programs underlying organized differentiation patterns. In particular, we are interested in:

(1) How the properties of intercellular signaling pathways contribute to the development of tissues and organs.

(2) How cellular mechanics and cellular morphology affect, and are affected by, regulatory processes within cells and signaling between cells.

To address these questions we use an interdisciplinary approach combining synthetic biology, quantitative imaging techniques, micropatterning technology and mathematical models.

# Dr. Haim Suchowski

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## Research Title

**Femto-nano dynamics, Nonlinear metamaterials, Quantum coherent control**

## Selected Publications

1. Levanon A, Dahan A, Nagler A, Lifshitz E, Bahar E, Mrejen M, Suchowski H., Pulse shaping of broadband adiabatic SHG from a Ti-sapphire oscillator, Opt Lett. 2017 Aug 1;42(15):2992-2995. doi: 10.1364/OL.42.002992.
2. Michaeli L, Keren-Zur S, Avayu O, Suchowski H, Ellenbogen T., Nonlinear surface lattice resonance in plasmonic nanoparticle arrays, Phys Rev Lett. 2017 Jun 16;118(24):243904. doi: 10.1103/PhysRevLett.118.243904.
3. Lavie A, Yadgarov L, Houben L, Popovitz-Biro R, Shaul TE, Nagler A, Suchowski H, Tenne R., Synthesis of core-shell single-layer MoS2 sheathing gold nanoparticles, AuNP@1L-MoS2, Nanotechnology. 2017 Jun 16;28(24):24LT03. doi: 10.1088/1361-6528/aa715f
4. Dahan A, Levanon A, Katz M, Suchowski H., Ultrafast adiabatic second harmonic generation, J Phys Condens Matter. 2017 Mar 1;29(8):084004. doi: 10.1088/1361-648X/29/8/084004.
5. O'Brien K, Suchowski H, Rho J, Salandrino A, Kante B, Yin X, Zhang X, Predicting nonlinear properties of metamaterials from the linear response, Nat Mater. 2015 Apr; 14(4):379-83. doi: 10.1038/nmat4214

## Research Description

Remarkable breakthroughs in science throughout history are inherently linked to advances in the study of light-matter interactions. For the past two decades we have witnessed major advances in nano-optics and ultrafast physics, allowing for the exploration of phenomena in higher spatial and temporal resolution than ever before. Research at our lab aims to merge these extreme resolution capabilities of space and time, in order to provide a window onto ultrafast spatio-temporal dynamics at the nanoscale. In particular, we are interested in exploring the ultrafast hot electron dynamics and related nonlinear effects in plasmonic nano-structures and metamaterials. Our current goal is to understand the effect of the nanoparticle's geometry and environment on the spatio-temporal evolution of the hot electron, and its relation to nonlinear optical generation.

Our research is driven by an attempt to combine theoretical microscopic models with novel experimental measurement methods, including: pulse-shaping-based measurements, ultrafast pump-probe spectroscopy, ultrashort light sources and near field microscopy.

We are also interested in exploring geometric quantum coherent control schemes. This approach, based on continuous (Lie) group theory, provides a route for determining whether a quantum system is controllable, not controllable or sub-controllable. Such methods have been harnessed in recent years to study control in many quantum and classical systems, such as nuclear magnetic resonance, optical spectroscopy, coherent control, solid state physics and frequency conversion.

# Prof. Tamir Tuller

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## Research Title

**Computation-based modeling and engineering of gene expression**

## Selected Publications

1. Ben-Yehezkel, Y., Atar, S., Zur, H., Diament, A., Goz, E., Marx, T., Cohen, R., Dana, A., Feldman, A., Shapiro, E., Tuller, T. (2015) Rationally designed, heterologous S. cerevisiae transcripts expose novel expression determinants. RNA Biol. 12(9):972-84.
2. Zur, H., Tuller, T. Exploiting hidden information interleaved in the redundancy of the genetic code without prior knowledge (2015). Bioinformatics. 2015 31(8):1161-8.
3. Dana, A., Tuller, T. The effect of tRNA levels on decoding times of mRNA codons (2014). Nucleic Acids Res. 42(14):9171-81.
4. Reuveni, S., Meilijson, I., Kupiec, M., Ruppin, E., Tuller, T. (2011) Genome-scale analysis of translation elongation with a ribosome flow model. PLoS Comput Biol. 7(9):e1002127
5. Tuller, T., Carmi, A., Vestsigain, K., Navon, S., Dorfan, Y., Zaborske, J., Pan, T., Dahan, O., Furman, I., Pilpel, Y. (2010) An evolutionarily conserved mechanism for controlling the efficiency of protein translation. Cell. 141(2):344-54.

## Research Description

Gene expression is the process by which information encoded in the genome is used to synthesize intra-cellular molecules such as proteins, which are involved in all intra-cellular activities. At our laboratory we develop predictive computational models for understanding, analyzing, simulating and engineering the different stages of gene expression. These models, based on both biophysical and stochastic aspects of the process, are used for answering basic scientific biomedical questions, as well as various biotechnological and medical challenges.

# Prof. Michael Urbakh

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## Research Title

**Theory and simulations of friction at the nanoscale**

## Selected Publications

1. Urbakh M., Klafter J., Gourdon D., Israelachvili J., The nonlinear nature of friction, Nature 430, 525-528 (2004).
2. Dudko O., Filippov A.E., Klafter J., Urbakh M., Beyond the conventional description of dynamic force spectroscopy of adhesion bonds, Proc. National Academy of Sciences USA, 100, 11378–11381 (2003).
3. Ma M, Grey F., Shen L., Urbakh M., Wu S., Liu Z. J., Liu Y and Zheng Q. Water transport inside carbon nanotubes mediated by phonon-induced oscillating friction, Nature Nanotech., 10, 692-696 (2015).
4. Ma M., Benassi A., Vanossi A., and Urbakh M., Critical length limiting superlow friction, Phys. Rev. Lett. 114, Art. 055501 (2015).
5. W. Ouyang, M. Ma, Q. Zheng, and M. Urbakh, Frictional properties of nanojunctions including atomically thin sheets. Nano Letters, 16, 1878–1883 (2016).

## Research Description

Since 1995, Michael Urbakh has been working on the theory of friction at the nano and mesoscales. Frictional motion plays a central role in diverse systems and phenomena that span a vast range of scales, from the nanometer contacts inherent in micro- and nano-machines and biological molecular motors, to the geophysical scales of earthquakes. The focus of research in the Michael Urbakh group is on a molecular level description of processes occurring between interacting surfaces in relative motion, which is needed to first understand, and later manipulate friction. Important new results obtained by Michael Urbakh in this field include:

- Understanding the mechanism of transition from stick-slip motion to sliding
- Predicting and characterizing new regimes of frictional motion, in particular chaotic stick-slip and inverted stick-slip motion
- Understanding the origin of a finite lifetime of superlubricity between incommensurate surfaces, and suggesting novel ways to stabilize the low-friction superlubric state
- Describing friction in terms of rupture and formation of surface junctions
- Describbong thermal effects on nanoscale friction, and understanding the origin of unexpected nonmonotonic dependence of nanoscale friction on temperature
- Understanding the mechanism of wear and ripple formation in nanoscale friction
- Understanding the mechanism of onset of sliding motion for elastic sliders with extended rough interfaces
- Bridging a gap between descriptions of friction at the nano and macroscales
- Developing novel methods for controlling friction using mechanics and chemistry
- A distinctive feature of research in the Michael Urbakh group is the development of minimal models which focus on a small number of the most relevant degrees of freedom of dynamical systems, but can nevertheless explain phenomena of high complexity.

# Prof. Meital Zilberman



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## Research Title

**Biodegradable polymers, tissue engineering and drug delivery systems, for the development of active (drug-eluting) implants and scaffolds for tissue regeneration**

## Selected Publications


1. Dafna Knani, Hilla Barkay-Olami, David Alperstein and Meital Zilberman, Simulation of novel soy protein-based systems for tissue regeneration applications, Polymers for Advanced Technologies, 28(4), 496-505 (2017).
2. Hilla Barkay-Olami and Meital Zilberman, Microstructure and in vitro cellular response to novel soy protein-based porous structures for tissue regeneration applications, Journal of Biomaterials Applications, 30(7), 1004-1015 (2016)
3. Hilla Barkay-Olami and Meital Zilberman, Novel soy-protein based porous blend structures for biomedical applications: microstructure, mechanical and physical properties, Journal of Biomedical Materials Research Part B: Applied Biomaterials, 104(6), 1109-1120 (2016).
4. Oded Pinkas and Meital Zilberman, Novel gelatin-alginate surgical sealants loaded with hemostatic agents, International Journal of Polymeric Materials and Polymeric Biomaterials, 66(8), 378-387 (2017).
5. Dafna Knani, Hilla Barkay-Olami, David Alperstein and Meital Zilberman, Simulation of novel soy protein-based systems for tissue regeneration applications, Polymers for Advanced Technologies, 28(4), 496-505 (2017).


## Research Description

Our lab works in the new, emerging field of 'active implants' - implantable medical devices made of biodegradable polymers. Remaining intact in the body for a predictable period of time - from weeks to years – these devices degrade with time into non-toxic products, without the need for surgical removal. The new field involves a thorough understanding of polymer physics, materials science, bioengineering, chemistry and biology. Our research combines biodegradable polymers, tissue engineering and drug delivery systems, to develop active (drug-eluting) implants and scaffolds for tissue regeneration. We investigate the effects of kinetic and thermodynamic parameters in the preparation process, on the microstructure and resulting properties (drug release profile, mechanical and physical properties, biocompatibility etc.). The results of our studies have great medical relevance, aiming to provide new solutions to basic needs in the fields of medical implants and tissue regeneration.

# PUBLICATIONS

# Publications (Sorted by Journal)

1. Ismach, H. Chou, Pc. Mende, A. Dolocan, R. Addou, S. Aloni, R. Wallace, Rm. Feenstra, Rs. Ruoff, L. Colombo, Carbon-Assisted Chemical Vapor Deposition of Hexagonal Boron Nitride, 2D Materials, 4, 25117 (2017).
2. Soumyendu Roy, Moshe David-Pur, and Yael Hanein, Carbon Nanotube Based Ion Selective Sensors for Wearable Applications, ACS Appl. Mater. & Interfaces , Doi: 0.1021/ Acsami.7B07346 (2017).
3. I. Amit, N. Jeon, L. J. Lauhon, and Y. Rosenwaks, The Impact of Dopant Compensation on Graded P-N Junctions in Si Nanowires, ACS Applied Materials & Interfaces, 8, 128-134 (2016).
4. Qi-Long Yan, Adva Cohen, Natan Petrutik, Avital Shlomovich, Jian-Guo Zhang, Michael Gozin, Formation of Highly Thermostable Copper-Containing Energetic Coordination Polymers Based on Oxidized Triaminoguanidine, ACSs Applied Materials & Interfaces, 8(33), 21674-21682 (2016).
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# Collaborations (Sorted by Country)

1. Ehud Gazit collaborates with Prof. David Vocadlo (Department of Chemistry, Simon Fraser University, Canada) on Chemistry and self assemly; Funded by: SAIA Foundation.
2. Natan Shaked collaborates with Yihui Wu (Chineese Academy of Sciences, China) on Nanofiber sensors enhanced with gold nanoparticles; Funded by: China Israel MOST grant.
3. Ayelet Lesman collaborates with Prof. Xu Xinpeng (Faculty of Science, Guangdong-Technion, China) on Analysis of cell-induced force transmission in nonlinear matrix by computational and analytical tools.
4. Michael Gozin collaborates with Siping Pang (School of Materials Science and Engineering, Beijing Institute of Technology, China) on Development of new energetic materials; Funded by: XIN.
5. Michael Gozin collaborates with Jian-Guo Zhang (School of Mechatronical Engineering, Beijing Institute of Technology, China) on Development of new energetic materials.
6. Ehud Gazit collaborates with Prof. Junbai Li (Physical Chemistry, Institute of Chemistry, CAS, China) on Physical Chemistry; Funded by: EU project.
7. Ehud Gazit collaborates with Yi Cao (Department of Physics, Nanjing University, China) on Self assembly; Funded by: EU project.
8. Michael Urbakh collaborates with Q. Zheng (Department of Mechanical Engineering, Tsinghua University, China) on Nanofriction.
9. Alexander Kotlyar collaborates with Prof. Leonid Gurevich (Department of Materials and Production Materials, Aalborg University, Denmark) on Conductivity of DNA nanowires.
10. David Andelman collaborates with Henri Orland (Inst for Theoretical Physics, CE-Saclay, France); Funded by: ISF.
11. Oded Hod collaborates with Thomas Fruaneheim (Material Science, BCCMS, Germany) on DLvN Approach; Funded by: GIF.
12. Natan Shaked collaborates with Bjorn Kemper (Munster University, Germany) on Nanoparticles in cells; Funded by: GIF.
13. Haim Diamant collaborates with Stefan Egelhaaf, Yael Roichman (Department of Physics, University of Dusseldorf, Germany) on Colloidal glasses; Funded by: GIF.
14. Yael Roichman collaborates with Stefan Egelhaaf (Physics, Dusseldorf University, Germany) on New signatures of the colloidal glass transition: Real-space and Fourier space fluctuations; Funded by: GIF.
15. Yael Roichman collaborates with Benjamin Lindner and Igor Sokolov (Physics, Humboldt University, Germany) on Generalized Fluctuation-Dissipation Theorem for a Driven System of Colloidal Particles; Funded by: Tel Aviv-University - Humboldt Universität Joint Call for Cooperation.
16. Uri Ashery collaborates with Markus Sauer (Biotechnology & Biophysics Biocenter, Wurzburg University, Germany).
17. Prof. Ronit Satchi-Fainaro collaborates with Prof. Rainer Haag, Dr. Marcelo Calderon (Institute of Chemistry and Biochemistry, Frei University Berlin, Germany) on Development of dendrimeric nanomedicine; Funded by: GIF.
18. Yoram Dagan collaborates with Jure Demsar (Exact, Mainz, Germany) on Electronic structure of cuprates; Funded by: GIF.
19. Yuval Ebenstein collaborates with Elmar Weinhold (Organic Chemistry, RWTH Aachen, Germany) on Methyltransferase assisted labeling; Funded by: GIF.
20. Michael Urbakh collaborates with R. Bennewitz (Department of Physics, Leibnitz Institute, Saarbrucken, Germany).
21. Moshe Goldstein collaborates with Prof. Jan von Delft (Physics, LMU Munich, Germany) on Theory of strongly-correlated optically-driven nanoelectronic systems; Funded by: GIF.
22. Diana Golodnitsky collaborates with Dr. Robert Dominko (Laboratory for Materials Chemistry, MEET Battery Research Center, KEMIJSKI INSTITUT, WESTFAELISCHE WILHELMS-UNIVERSITAET MUENSTER, Germany, Slovenia) on High energy lithium sulphur cells and batteries; Funded by: EU project.
23. Itai Benhar collaborates with Prof. Nir Osherov, Department of Clinical Microbiology and Immunology, Sackler School of Medicine (Sackler School of Medicine, Tel Aviv University, Israel) on Targeted antifungal nanomedicines.
24. Itai Benhar collaborates with Prof. Dan Peer (Life Sciences, Tel Aviv University, Israel) on Targeted lipid nanoparticles; Funded by: Helmlsey Fund.
25. Itai Benhar collaborates with Prof. Alex Szpilman (School of Chemistry, Ariel University,

Israel) on Targeted antifungal nanomedicines.

26. Oded Hod collaborates with Leeor Kronik (Chemistry, Weizmann Institute, Israel) on Electron dynamics in open quantum systems and Interlayer Interactions in Layered Materials.
27. Oded Hod collaborates with Abraham Nitzan (Exact Sciences, Tel Aviv University, Israel) on Electron Dynamics in Open Quantum Systems; Funded by: ISF.
28. Oded Hod collaborates with Michael Urbakh (Exact Sciences, Tel Aviv University, Israel) on Nanotribology; Funded by: ISF.
29. Alexander Kotlyar collaborates with Prof. Danny Porath (Physical Chemistry, Hebrew University, Israel) on DNA-nanoelectronics ; Funded by: ISF.
30. Jacob Scheuer collaborates with Amir Boag (EE, Tel Aviv University, Israel) on Flat and Ultrathin Optical Components; Funded by: Xin.
31. Yair Shokef collaborates with Yael Roichman (Chemistry, Tel Aviv University, Israel) on Active Fluctuations.
32. Shachar Richter collaborates with Hagai Cohen (Research Services, Weizmann Institute, Israel) on CREM.
33. Amir Goldbourt collaborates with Roy Beck (School of Physics and Astronomy, Tel Aviv University, Israel) on Combined SAXS/NMR studies of filamentous viruses.
34. Amir Goldbourt collaborates with Miron Landau (Chemical Engineering, Ben-Gurion University, Israel) on Development and characterization of materials for catalysis.
35. Amir Goldbourt collaborates with Yoram Cohen (School of Chemistry, Tel Aviv University, Israel) on Characterization of solvent molecules embeded in hexameric capsules.
36. Haim Diamant collaborates with David Andelman (School of Physics, Tel Aviv University, Israel) on Heterogeneously charged surfaces.
37. Haim Diamant collaborates with Yael Roichman (School of Chemistry, Tel Aviv University, Israel) on Microrheology.
38. Haim Diamant collaborates with Eran Sharon (Racah Institute of Physics, Hebrew University, Israel) on Frustrated nano-ribbons.
39. Haim Diamant collaborates with Rony Granek (Biotechnology Engineering, Ben-Gurion University, Israel) on Membrane dynamics.
40. Yael Roichman collaborates with Haim Diamant (Chemistry, Tel Aviv University, Israel) on New signatures of the colloidal glass transition: Real-space and Fourier space fluctuations.; Funded by: GIF.
41. Yael Roichman collaborates with Ady Arie (Electrical Engineering, Tel Aviv University, Israel) on optical trapping in super oscillating beams.
42. Yael Roichman collaborates with Alon Bahabad (Electrical Engineering, Tel Aviv University, Israel) Funded by: Tel Aviv University - Humboldt Universität Joint Call for Cooperation.
43. Eli Eisenberg collaborates with Erez Levanon (Bar-Ilan University, Israel) ; Funded by: ISF.
44. Diana Golodnitsky collaborates with Fernando Potolsky (School of Chemistry, Tel Aviv University, Israel) on Development of silicon nano structure based high energy anodes for lithium ion battery; Funded by: Momentum Fund.
45. Chanoch Carmeli collaborates with Itai Carmeli (Engineering, Ben-Gurion University, Israel); Funded by: University.
46. Chanoch Carmeli collaborates with Shachar Richter (Engineering, Tel Aviv University, Israel); Funded by: University.
47. Tamir Tuller collaborates with Michael Margaliot, (Engineering, Tel Aviv University, Israel) on mRNA translation modeling; Funded by: BSF.
48. Tamir Tuller collaborates with Eduardo D. Sontag (Math, Rutgers University, Israel) on Modeling mRNA translation ; Funded by: BSF.
49. Tamir Tuller collaborates with Iftach Yacoby (Life Science, Tel Aviv University, Israel) on Modeling gene expression in micro-algae; Funded by: MOST.
50. Tamir Tuller collaborates with Assaf Zemach (Life Science, Tel Aviv University, Israel) on DNA methylation in arabidopsis.
51. Tamir Tuller collaborates with Daniel A. Chamovitz (Life Science, Tel Aviv University, Israel) on DNA methylation in arabidopsis.
52. Tamir Tuller collaborates with Yoav Arava (Life Science, Technion, Israel) on Ribosome profiling.
53. Ronit Sagi-Eisenberg collaborates with Ofer Merimsky (Medicine, Tel Aviv University, Israel)
54. Yoni Haitin collaborates with Daniel Khananshvili (Medicine, Tel Aviv University, Israel) on Molecular mechanism of NCX function.
55. Yoni Haitin collaborates with Reuven Wiener (Medicine, Hebrew University, Israel)

on SAXS studies of novel tri-ubiquitin chain linkages.

56. Gil Markovich collaborates with Yoram Dagan (Physics, Tel Aviv University, Israel) on Solution monolayer epitaxy; Funded by: Kamin.
57. Gil Markovich collaborates with Yitzhak Mastai (Chemistry, Bar-Ilan University, Israel) on Microcalorimetry of chiral crystals.
58. Gil Markovich collaborates with Ori Cheshnovsky (Chemistry, Tel Aviv University, Israel) on Single particle circular dichroism.
59. Yoni Haitin collaborates with Anat Loewenstein (Division of Ophtamology, Tel Aviv Medical Center, Israel) on Structural and functional studies of human DHDDS; Funded by: ISF.
60. Gil Markovich collaborates with Dan Oron (Physics, Weizmann Institute, Israel) on Chiroptical effects in quantum dots interacting with chiral molecules.
61. Slava Krylov collaborates with Rivka Gilat (Civil Engineering, Ariel University, Israel) on Stability of Micro Shells; Funded by: ISF.
62. Slava Krylov collaborates with Yosi Shacham (Engineering, Tel Aviv University, Israel) on Electrostrictive materials; Funded by: MOST.
63. Slava Krylov collaborates with Igor Lubomirsky (Department of Materials and Interfaces, Weizmann Institute, Israel) on Electrostrictive materials; Funded by: MOST.
64. Ayelet Lesman collaborates with Prof. Roy Beck (Physics, Tel Aviv University, Israel) on The relation between cell's stiffness and forces applied on 3D extracellular; Funded by: Ela Kodesz Institute for Medical Physics and Engineering.
65. Ayelet Lesman collaborates with Prof. Nahum Kiryati (Faculty of Engineering, Electrical Engineering, Tel Aviv University, Israel) on Image analysis of deformed fibrous networks.
66. Hadas Mamane collaborates with Yoram Gerchman (Department of Biology, University of Haifa at Oranim, Haifa University, Israel) on Innovative LED based disinfection; Funded by: Nofar.
67. Hadas Mamane collaborates with Carlos Desoretz, Yitzhak Hadar, Dror Avisar, Yael Mishael (Environmental Engineering, Technion, Hebrew University, Israel) on Integrating physical, chemical and biological technologies for advanced treatment of persistent micro-pollutants from treated wastewater effluent; Funded by: Ministry of Science, Technology & Space.
68. Rimona Margalit collaborates with Jonathan Leor (Faculty of Medicine, Tel Aviv University, Israel) on Cardiovascular disease; Funded by: The Helmsly Fund, FTA.
69. Rimona Margalit collaborates with Prof. Dan Peer (Life Sciences, Tel Aviv University, Israel) on Kinetics of dexamethasone or diclofenac release from collagomers, under conditions modeling local administration; Funded by: INNOCOLL AG, Athlone, Ireland.
70. Dr. Yoav Linzon collaborates with Dr. Mordechai Fridman, Department of Engineering, Bar-Ilan University (Department of Engineering, Bar-Ilan University, Israel) on Microknot photomechanical resonators; Funded by: Israel MOST.
71. Prof. Ronit Satchi-Fainaro collaborates with Prof. Doron Shabat (Faculty of Chemistry, Tel Aviv University, Israel) on Development of luminescence probes for theranostics.
72. Prof Ronit Satchi-Fainaro collaborates with Dr. Neta Erez (Faculty of Medicine, Tel Aviv University, Israel) on Microenviroment crosstalk between melanoma and host; Funded by: MRA.
73. Ilan Goldfarb collaborates with Amit Kohn, Oswaldo Dieguez (Department of Materials Science and Engineering, Tel Aviv University, Israel) on Magnetic nanostructures; Funded by: ISF.
74. Ilan Goldfarb collaborates with Shachar Richter, Arie Ruzin (Faculty of Engineering, Tel Aviv University, Israel) on Memristor technology; Funded by: MOST Scientific, Applied and Engineering.
75. Yuval Ebenstein collaborates with Amit Meller (Biomedical Engineering, Technion, Israel) on Epigenetic sensing in solid state nanopores; Funded by: ISF.
76. Michael Gozin collaborates with Brian A. Rosen (Department of Materials Science and Engineering / Faculty of Engineering, Tel Aviv University, Israel) on Development of new catalysts for GTL process.; Funded by: Ramot.
77. Sharly Fleischer collaborates with Dina Golodnitsky, Shimshon Kallush, Gil Markovich (Chemistry, Physics, Tel Aviv University, Ort Braude, Israel) on THz spectroscopy of transparent eletrodes, THz spectroscopy of battery electrodes, Coherent control of molecular angular distributions in the gas phase; Funded by: ISF.

78. Dr. Alexander Golberg collaborates with Prof. Yoav Livney (Food Engineering, Technion, Israel) on Starch extraction from macroalgae with pulsed electric fields; Funded by: Ministry of Science.
79. Amit Kohn collaborates with Prof. Ilan Goldfarb (Materials Science and Engineering, Tel Aviv University, Israel) on magnetic response of epitaxial iron-silicide nanoislands; Funded by: ISF.
80. Amit Kohn collaborates with Prof. Yuval Golan (Materials Engineering, Ben-Gurion University, Israel) on Mapping charge distribution in single PbS core–CdS arm nano-multipod heterostructures by off-axis electron holography.
81. Amit Kohn collaborates with Prof. Yoram Dagan (Physics, Tel Aviv University, Israel) on Signature for surface states in the topological Kondo insulator SmB6 from temperature dependence of the anisotropic magnetoresistance.
82. Amit Kohn collaborates with Prof. S. Hayun (Materials Engineering, Ben-Gurion University, Israel) on Charge distribution in nano-scale grains of magnesium aluminate spinel.
83. Moshe Portnoy collaborates with Adi Dahan, Revital Sasson (Chemistry, Soreq NRC, Israel) on Selective, high affinity ligands for the actinides as tools for forensic and medical applications; Funded by: Pazy.
84. Moshe Portnoy collaborates with Gerardo Lederkremer (Life Sciences, Tel Aviv University, Israel) on PERK inhibitors.
85. Ehud Gazit collaborates with Prof. Leeor Kronik (Faculty of Chemistry Materials and Interfaces, Weizmann Institute, Israel) on Peptide self-assembling mechanical materials; Funded by: EU project.
86. Ehud Gazit collaborates with Oded Hod (School of Chemistry, Tel Aviv University, Israel) on Self assembly; Funded by: EU project.
87. Ehud Gazit collaborates with Dr. Linda J.W. Shimon (X-Ray Crystallography Lab, Weizmann Institute, Israel) on Crystallography; Funded by: ISF.
88. Michael Urbakh collaborates with Oded Hod (School of Chemistry, Tel Aviv University, Israel); Funded by: ISF.
89. Ehud Gazit collaborates with Dr. Haim Barr (Maurice and Vivienne Wohl Institute for Drug Discovery, The Nancy & Stephen Grand Israel National Center for Personalized Medicine (INCPM), Weizmann Institute, Israel) on Screen for metabolite aggregation; Funded by: ISF.
90. Ehud Gazit collaborates with Dr. Yair Anikster (The Pediatric Metabolic Disease Unit, The Edmond & Lily Safra Children's Hospital, Sheba Medical Center, Israel) on PKU patients and therapeutic options; Funded by: ISF.
91. Prof. Gil Rosenman collaborates with Dr. A. Natan, Dr. T. Ellenbogen, Dr. B. Apter, Dr. A. Handelman, Prof. B. Fainberg, Prof. J. Zyss (Engineering, Tel Aviv University, Holon Institute of Technology, Israel, France) on Bioinsppred materials; Funded by: Min Science, Israel.
92. Moshe Goldstein collaborates with Prof. Yuval Gefen, Prof. Igor Burmistrov (Physics, Weizmann Institute, Landau Institute, Moscow, Israel, Russia) on Topology and quantum phase transitions on the edge; Funded by: MOST (Israel-Russia).
93. Inna Slutsky collaborates with Ehud Gazit (TAU), Yuval Nir (TAU), Yaiv Ziv (WIS), Dominic Walsh (Harvard) (Israel, Tel Aviv University, Weizmann Institute, Harvard, Israel, USA); Funded by: ERC.
94. Oded Hod collaborates with Erio Tosatti (Physics, SISSA, Italy) on Nanotribology; Funded by: ISF.
95. Alexander Kotlyar collaborates with Prof. Clelia Giannini (Dipartimento di Chimica, University of Milan, Italy) on DNA/PNA structures.
96. Ronit Satchi-Fainaro collaborates with Prof. Paolo Caliceti (Faculty of Pharmacy, University of Padova, Italy) on Polyplexes for cancer treatment.
97. Ronit Sagi-Eisenberg collaborates with Mitsunori Fukuda (Department of Developmental Biology and Neurosciences, Mitsunori Fukuda Tohoku University, Japan); Funded by: ISF.
98. Yair Shokef collaborates with Martin van Hecke (Physics, Leiden University and AMOLF, Netherlands) on Mechanical metamaterials.
99. Ronit Satchi-Fainaro collaborates with Dr Helena Florindo (Faculty of Pharmacy, University of Lisbon, Portugal) on Nanovaccine for tumor treatment; Funded by: Euronanomed.
100. Alexander Kotlyar collaborates with Prof. Sergey Deev (Department of Molecular Immunology, Institute of Bioorganic Chemistry, Russia) on Biomedical applications of nanoparticles.
101. Yuval Ebenstein collaborates with Fredrik Westerlund (Biophysical Chemistry,

Chalmers University, Sweden) on DNA mapping in nanochannels; Funded by: EU project.

**102.** Michael Urbakh collaborates with Ernst Meyer (Department of Physics, Basel University, Switzerland).

**103.** Gil Markovich collaborates with Ventsislav Valev (Physics, University of Bath, UK) on Second harmonic generation circular dichroism of chiral nanoparticles.

**104.** Uri Ashery collaborates with Maria-Grazia Spillantini, (Department of Clinical Neurosciences, University of Cambridge, UK).

**105.** Amit Kohn collaborates with Prof. T. Hesjedal (Physics, Oxford University, UK) on Strain in epitaxial MnSi films on Si(111) in the thick film limit studied by polarization-dependent extended x-ray absorption fine structure.

**106.** Ehud Gazit collaborates with Prof. Tuomas P.J. Knowles (Department of Chemistry, Cambridge University, UK) on Self assembly and nano structures; Funded by: Adelis.

**107.** Michael Urbakh collaborates with A. A. Kornyshev (Department of Chemistry, Imperial College, London, UK); Funded by: ISF.

**108.** Oded Hod collaborates with Jeff Neaton (Chemistry, Berkeley, USA) on Driven Liouville von Neumann Approach; Funded by: Internal TAU account.

**109.** Jacob Scheuer collaborates with Bob Byer (Applied Physics, Stanford University, USA) on Laser driven plasmonic accelerators; Funded by: BSF.

**110.** Jacob Scheuer collaborates with Selim Shahriar (EECS, Northwestern University, USA) on Slow & fast light.

**111.** Yair Shokef collaborates with Aparna Baskaran and Bulbul Chakraborty (Physics, Brandeis University, USA) on Influence of mechanical stress on structure and dynamics of tissues and cell sheets; Funded by: BSF.

**112.** Iftach Nachman collaborates with Rajanikanth Vadigepalli (Pathology, Thomas Jefferson University, USA) on Integrated live imaging and molecular profiling of embryoid bodies; Funded by: ISF.

**113.** Haim Diamant collaborates with Thomas A. Witten (Department of Physics, University of Chicago, USA) on Self-aligning colloids; Funded by: BSF.

**114.** Roy Beck collaborates with Omar Salah (Physics, UCSB, USA) on Direct force measurements and analysis of intrinsically disordered proteins; Funded by: NSF-BSF.

**115.** Yael Roichman collaborates with David Pine and Anne Bernheim (Physics and Chemical Engineering, Ben-Gurion University, USA) on How Actomyosin network self-organization begins in the cytoskeleton; Funded by: BSF.

**116.** Eli Eisenberg collaborates with Joshua Rosenthal (Eugene Bell Center, Marine Biological Laboratory, Woods Hole, MA 02543, USA, MBL, USA) on RNA editing in cephalopods; Funded by: BSF.

**117.** Guy Cohen collaborates with Emanuel Gull (Physics, University of Michigan, USA); Funded by: BSF.

**118.** Guy Cohen collaborates with David Reichman (Chemistry, Columbia University, USA); Funded by: The Sackler Center for Computational Molecular and Materials Science.

**119.** Ronit Sagi-Eisenberg collaborates with Stephen J Galli (Departments of Pathology and of Microbiology and Immunology, Stanford University, USA); Funded by: BSF.

**120.** Ron Lifshitz collaborates with Michael Cross (Physics, Caltech, USA) on Nanomechanics; Funded by: BSF.

**121.** Ron Lifshitz collaborates with Keith Schwab (Physics, Caltech, USA) on Nanomechanics; Funded by: BSF.

**122.** Ron Lifshitz collaborates with David Hsieh (Physics, Caltech, USA) on Novel long range order.

**123.** Yoni Haitin collaborates with William N. Zagottan (Health Sciences, University of Washington, USA) on The molecular basis of CNG channels function.

**124.** Slava Krylov collaborates with Bojan R. Ilic (Center of Nanoscale Science and Technology, National Institute of Standards and Technology (NIST), USA); Funded by: NSF.

**125.** Slava Krylov collaborates with Alan Zehnder (Sibley School of Mechanical and Aerospace Engineering, Cornell University, USA); Funded by: NSF.

**126.** Ayelet Lesman collaborates with Prof. Irina Conboy (Bioengineering, Berkeley, USA) on Biomechanical determinants of stem cell asymmetric division; Funded by: The Raymond and Beverly Sackler Fund for Convergence Research in Biomedical, Physical and Engineering Sciences.

**127.** Yoram Dagan collaborates with Harold Y Hwang (Physics, Stanford, USA) on Polar vs. nonpolar heterostructures; Funded by: BSF.

128. Yuval Ebenstein collaborates with Natalie R. Gassman (USA Mitchell Cancer Institute, University of South Alabama, USA) on DNA damage in cancer; Funded by: NIH.
129. Yuval Ebenstein collaborates with Kevin Dorfman (University of Minnesota, USA) on Chemical Engineering and Materials Science.
130. Moshe Portnoy collaborates with Scott J. Miller (Chemistry, Yale University, USA) on New approaches for site-selective catalytic transformations of di- and polyols; Funded by: BSF.
131. Ehud Gazit collaborates with Prof. William F. DeGrado (School of Pharmacy Department of Pharmaceutical Chemistry, University of California, USA) on Self-assembling dipeptide antibacterial nanostructures; Funded by: MOST.
132. Ehud Gazit collaborates with Prof. Petr Král (Department of Chemistry, University of Illinois at Chicago, USA) on Molecular dynamics simulations; Funded by: ISF.
133. Moshe Goldstein collaborates with Prof. Vladimir Manucharyan (Physics, University of Maryland, USA) on Probing nonequilibrium strongly-correlated superconducting circuits at the single photon level: Theory and experiment; Funded by: BSF.

# Special Awards

1. Oded Hod received the Kadar Family Award for Outstanding Research from Tel Aviv University and the Naomi Kadar Foundation
2. Roey Amir received the PMSE Young Investigator 2017 from the Polymeric Materials: Science & Engineering Division of the American Chemical Society
3. Jacob Scheuer received the Fellow of the OSA from the Optical Society of America
4. Roy Beck received the Juludan Research Prize from the Juludan Research Prize Fund (Technion)
5. Guy Cohen received the Herman KÜmmel Early Achievement Award in Many-Body Physics from the International Advisory Committee responsible for the International Conference series on "Recent Progress in Many-Body Theories"
6. David Andelman received the President's International Fellowship Initiative (PIFI) from the Chinese Academy of Sciences
7. David Andelman received the Humboldt Re-Invitation Award from the Alexander von Humboldt Foundation, Germany
8. Yoni Haitin received the Research Career Development Award from the Israel Cancer Research Association
9. Slava Krylov received the Best Paper Award of the Design Engineering Division, Micro and Nano Systems Technical Committee at the 11$^{th}$ Micro Nano Systems Conference in the framework of the ASME International Design Engineering Technical Conferences IDETC/CIE 2017, Cleveland, from ASME – the American Society of Mechanical Engineers
10. Roni Ilan received the Alon Fellowship from the Council for Higher Education
11. Ady Arie received the Kadar Foundation Award from the Naomi Prawer Kadar Foundation
12. Abraham Nitzan received the 2017 Hirshfelder Prize in Theoretical Chemistry from the University of Wisconsin
13. Amit Sitt received the The Azrieli New Faculty Fellowship from the Azrieli Foundation
14. Inna Slutsky received the Metlife Foundation Award for Research in Alzheimer's Disease from the MetLife Foundation
15. Dan Peer received the Nanos Award, 2017, from the CLINAM, Basal, Switzerland
16. Johann Elbaz received the Adelis Foundation - Young Scientist Award from the Adelis Foundation
17. Lee Schnaider received the Young Investigator Award at the Gordon Conference on Antimicrobial Peptides from the Gordon Conference on Antimicrobial Peptides
18. Lee Schnaider received the Shulamit Aloni Scholarship for Advancing Women in Exact Sciences from the Ministry of Science and Technology
19. Lee Schnaider received the Ahraon and Ephraim Katzir Fellowship from the Ahraon and Ephraim Katzir Foundation
20. Dorin Sade received the Mariana and George SAIA Foundation Scholarship for Parkinson's Research from the Mariana and George SAIA Foundation
21. Shira Shaham Niv received the Strauss and Danone Institute Scholarship for PhD students from the Strauss Group
22. Ilan Tsarfaty received the Breast Cancer Research Foundation Award from the Breast Cancer Research Foundation

# Spinoffs

## Startups

- Optomechanic Cube Ltd. (2017) - A company developing 3D modular optics for 3D optical alignment. Lead researcher: Dr. Haim Suchowski
- CliniCrowd (2016) - A crowd monitoring website to evaluate Mannitol for the treatment of Parkinson's. Lead researcher: Prof. Daniel Segal
- Pntlloxx Ltd. (2016) - A company developing Peptide Nanotubes for energy storage applications. Lead researcher: Prof. Ehud Gazit
- QuLab Medical Ltd. (2016) - A company developing multiplex real-time monitoring of cellular metabolic activity in physiological solutions using a Redox-reactive nanowire biosensor. Lead researcher: Prof. Fernando Patolsky
- Unispectral Ltd. (2016) - A company developing a sequential color imaging scheme and implementation within compact camera modules. Lead researchers: Prof. Slava Krylov and Prof. David Mendlovic
- NanoLock (2015) - A company developing a technology to enable any solid-state memory to be physically "locked," preventing unauthorized access at the hardware level. Furthermore, complete functionality of CPUs and MicroControllers can also be "locked" and disabled. Lead researcher: Prof. Slava Krylov
- NanoAir (2014) - A startup company developing paper-thin active cooling for thin devices. Lead researchers: Prof. Slava Krylov and Prof. Yosi Shacham
- Cine'al (2014) - A startup company developing jellyfish-derived super absorbents for fluids, with a focus on absorbing blood and proteins. Lead researcher: Prof. Shachar Richter
- Honeycomb Battery (2014) – A startup company based on 3D concentric on-chip silicon microbattery technology, enabling fabrication of 10-30K microbattery units in the perforated chip. Lead researchers: Prof. Diana Golodintsky, Prof. Emanuel Peled and Prof. Menachem Nathan
- StoreDot Ltd (2013) - A leader in the innovation of materials and their device applications, developing groundbreaking technologies based on a unique methodology for the design, synthesis and tuning of new organic compounds. These proprietary compounds dramatically improve the performance of a range of devices, including batteries, displays, sensors and digital memory. Lead researcher: Prof. Gil Rosenman
- NoAm ColorTech (2013) - A startup company developing novel hair coloring using unique strongly adhering coating beads. Lead researcher: Prof. Amihay Freeman
- Savicell Diagnostics (2012) - A cancer diagnostic kit. Lead researcher: Prof. Fernando Patolsky
- Quiet Therapeutics (2010) - A startup company developing a drug delivery technology. Lead researchers: Prof. Rimona Margalit and Prof. Dan Peer
- Tracense Systems (2010) - A startup company developing a nanotech-based "electronic nose" to sniff out security threats like bombs, biological warfare agents and toxic liquids. Lead researcher: Prof. Fernando Patolsky

## License Agreements

- 3PEMS Ltd. (2017) - 3D Printed electromagnetic systems for RF applications. Lead researcher: Prof. Yosi Shacham
- BIOSYNTH AG (2016) - Chemiluminescent probes for diagnostics and in vivo imaging. Lead researcher: Prof. Doron Shabat
- Sepal Pharma (2016) - Drug delivery via sublingual delivery. Lead researcher: Prof. Dan Peer
- Semiconductor Research Corporation SRC, Intel Corporation (2016) - Synthesis conversion to high Phosphorus Nitride thin films. Lead researcher: Prof. Fernando Patolsky
- Aerie Pharmaceuticals (2015) - First-in-class therapies for anti-beta amyloid small molecules for the treatment of patients with glaucoma and dry AMD and other eye diseases. Lead researcher: Prof. Ehud Gazit
- Dexcel Pharma Technologies (2015) – Parkinson's disease therapy, based on the identification of new beta-synuclein recognition modules. This disease-modifying treatment may enable inhibition of disease progression, in contrast to current symptomatic therapy that does not arrest disease progression. Lead researcher: Prof. Ehud Gazit
- Civan Advanced Technology (2015) - Development of a high-

power laser based on the coherent combination of fibers. Lead researcher: Prof. Shlomo Ruschin

- Variantyx Ltd. (2014) – Clinical grade, end-to-end genome analysis services for physicians and hospitals worldwide. Lead researcher: Dr. Noam Shomron
- Hall Effect Multi-bit Magnetic Random Access Memory (MRAM), signed with Samsung Global MRAM Innovation. Lead researcher: Prof. Alexander Gerber (2014)
- PEG-dendrimer hybrids as novel nano-carriers for pesticide delivery, signed with Makhteshim Chemical Works Ltd. Lead researcher: Dr. Roey J. Amir (2014)
- A novel approach to fuel marking, signed with Eurocontrol Technics Group Inc. (TSX Venture: EUO). Lead researcher: Prof. Fernando Patolsky (2014)
- Discrimination of white blood cell populations with label-free digital holographic microscopy, signed with Siemens AG. Lead researcher: Dr. Natan Tzvi-Shaked (2014)
- Optical interferometry microscopy system and algorithms for non-destructive optical inspection, signed with Applied Materials Israel Ltd. Lead researcher: Dr. Natan Tzvi-Shaked (September 2014)
- Electrochemical deposition of hydroxyapatite on dental implants, signed with SGS International Ltd. Lead researcher: Prof. Noam Eliaz (2014)
- Nonpharma, polypeptide nanostructures for use in products of field effect transistors, signed with The Technical University of Denmark (DTU). Lead researcher: Prof. Ehud Gazit (2013)
- Fluorescent nanomaterial for product authenticity verification, signed with Tata Steel Ltd. Lead researcher: Prof. Gil Markovich (2013)
- Phenylalanine fibrils antibodies related to PKU, signed with EMD Millipore Corporation. Lead researcher: Prof. Ehud Gazit. (2013)
- New drugs to treat schizophrenia and bipolar disorder, signed with Mental-Heal Ltd. Lead researchers: Prof. Moshe Portnoy, Prof. Avi Weizman and Dr. Irit Gilad (2013)
- Targeted cancer therapy based on miR-21, signed with Tickro Technologies. Lead researchers: Dr. Ella Sklan and Dr. Rina Rosin-Arbesfeld (2013)
- Improving laser efficiency in OPO laser systems for airborne defense systems against heat-seeking missiles, signed with Elbit Systems-Elop. Lead researcher: Prof. Ady Arie (February 2012)
- Coral-derived collagen for tissue engineering, signed with ExceeMatrix Ltd. Lead researcher: Prof. Dafna Benayahu (2012)
- Drug-eluting composite structures, signed with Active Healing Bio Medical Ltd. Lead researcher: Prof. Meital Zilberman (2012)
- Transparent conductive coating with nanowires for flat panel applications, signed with Nepes. Lead researcher: Prof. Gil Markovich (2012)
- A new drug for Parkinson's disease, signed with Bioline Rx. Lead researcher: Prof. Ehud Gazit (2012)
- Peptide nanotube electrodes for energy storage applications, signed with an Israeli defense industry company. Lead researchers: Prof. Ehud Gazit and Prof. Gil Rosenman (2010)
- Transparent conducting nanowires, signed with an Israeli startup in the field of photovoltaic coatings. Lead researcher: Prof. Gil Markovich (2009)

# Staff

## Core Staff

| | |
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| Prof. Yael Hanein | Director |
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| Ms. Michal Shenhar | Administrative Director |
| Ms. Noa Shafir | Secretary |
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- The Edouard Seroussi Chair for Protein Nanobiotechnology
- The Hermann and Kurt Lion Chair in Nanosciences and Nanotechnologies
- The Bernard L. Schwartz Chair in Nanoscale Information Technology
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