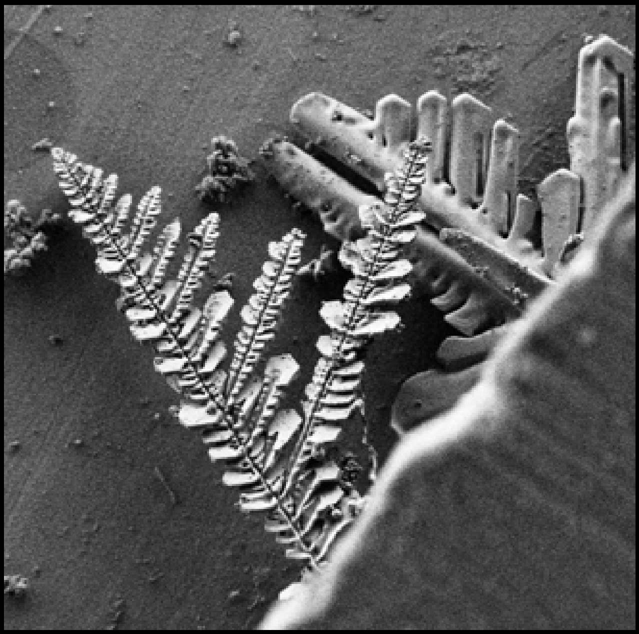
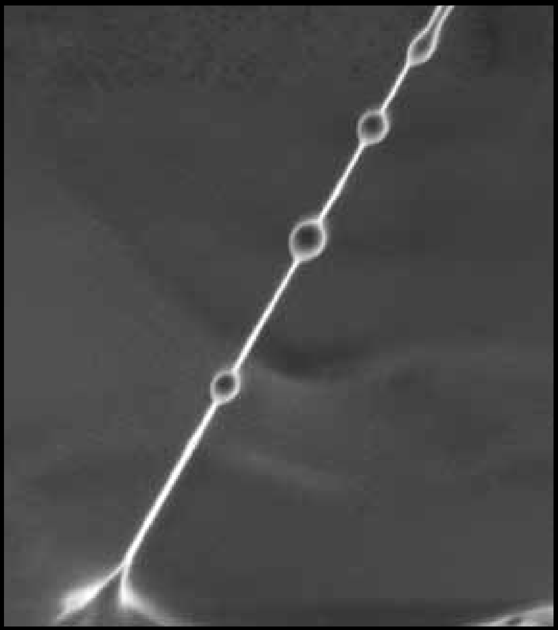
Technion Pananorama



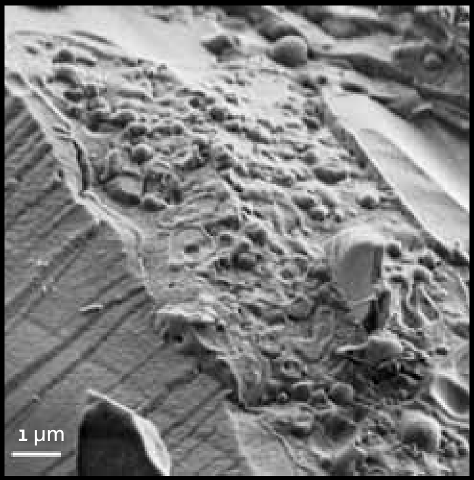


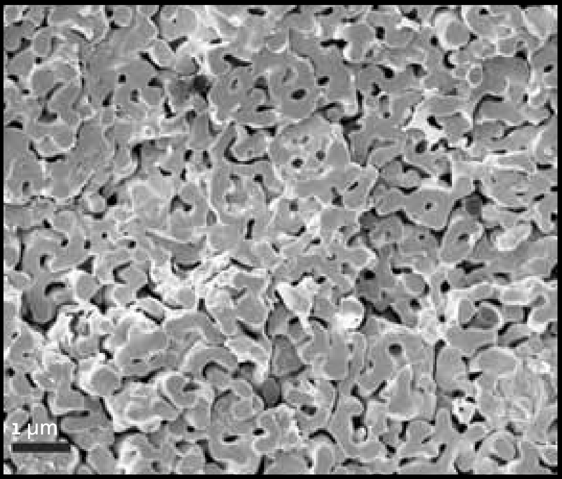
Nano-ice flakes in the cryoscanning electron microscope as observed by Ms. Olga Kleinerman of Prof. Ishi Talmon's group.

Cryo SEM of nano drops of chlorosulfonic acid on acid-coated carbon nanotube observed by Ms. Olga Kleinerman of Prof. Ishi Talmon's group.

Cryo-SEM of a fractured cell in a hydrogel as observed by Maya Schnabel, a joint student of Prof. Dror Seliktar and Prof. Ishi Talmon.

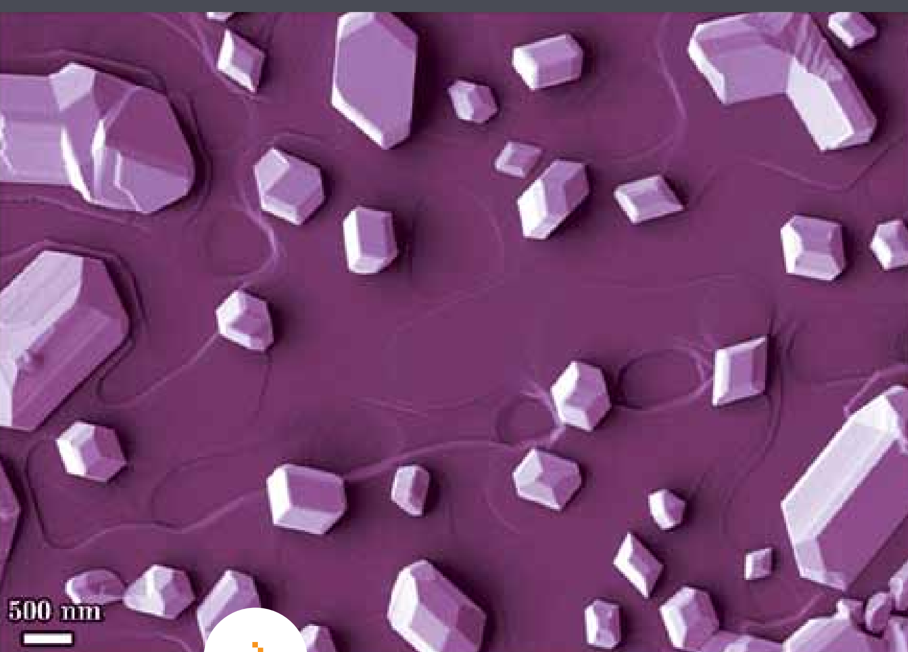
Oil-water bicontinuous microemuslsion as observed by Irina Davidovich of Prof. Ishi Talmon's group.





THE Nano Review 2012/14

Faculty Profiles



W particles (false color) on a sapphire substrate in the presence of anortthite (Al_2O_3 - CaO -2SiO_2, acquired using the LEO by Amir Avishai (Prof. Wayne D. Kaplan).

Nanoscan

"We live in extremely exciting times with respect to how science is to be done"

- Prof. Amit Meller

Prof. Amit Meller was recruited as part of the NanoMed project. Prof. Meller and his international team of multidisciplinary scientists are developing novel single molecule methods for genome analyses based on opto-electrical sensing of biomolecules, such as DNAs, RNAs and proteins, by threading them through nanometer scale pores.

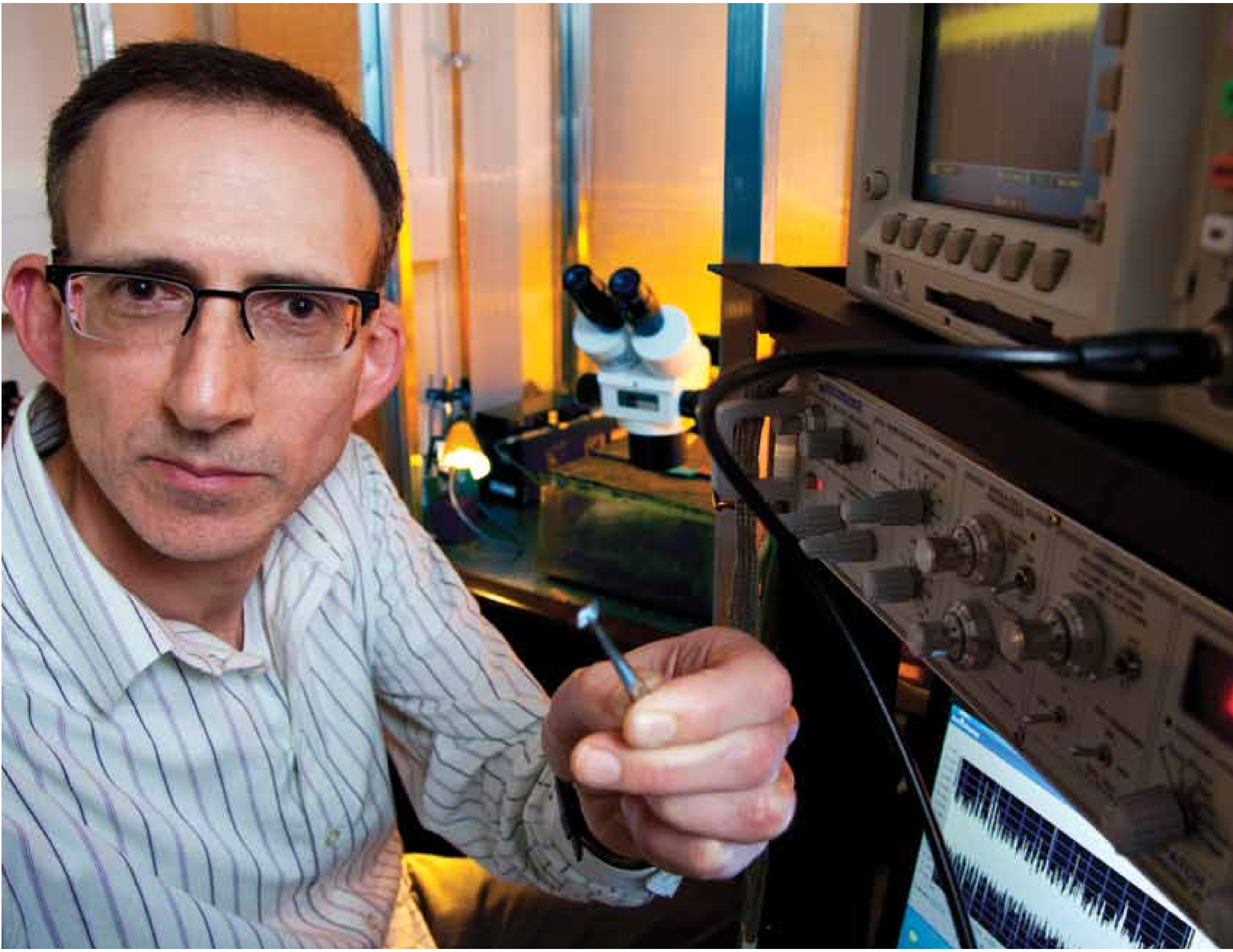
"A revolution in genome sequencing technologies, and their biomedical applications is underway," says Prof. Amit Meller. In the near future precise diagnosis and medication will become possible by real-time, genetic analysis of patients' needs from a device that will be about the size of a desktop printer.

Imagine you walk into the office of your doctor. You have been suffering from heartburn, and are worried, as your uncles both died of heart disease. The doctor takes a sample, and within twenty minutes can give you a genetic read-out that can be used to better identify the source of the pain, and inform the doctor which medications will work effectively in your specific case, and which will not. You will know if you are at risk or if heartburn just suggests less fried foods. General medicine has undergone a revolution. The above scenario would be just one outcome of the coming revolution in medical diagnostics, says Prof. Amit Meller. The efficient, fast and highly effective genome sequencing platforms of the future will impact scientific research across the frontiers, creating undreamed of possibilities for the treatments and drug developments of tomorrow. Prof. Meller's company, NobleGen Biosciences is active in producing such tools for the next generation of medical treatment and research. At Prof. Meller's two labs at the Technion and at Boston University, the integrated science and engineering teams are developing technologies relevant to the life sciences of tomorrow.

"My hope is that the way disease will be diagnosed in the next decades will be different from what we have been doing so far," says Prof. Meller. "There is a convergence of multiple technologies involving information processing knowledge on the genomic level and the ability to process a very small number of cells. The biomolecular diagnostic companies are looking towards a transition to tools that rely on ultra-fast genome analyses, to be used in any clinic. We will have the research tools and knowledge to look at a person's genome, and to choose the most efficient drugs. It's just a matter of bringing those technologies to the diagnostic market."

As a freshmen student at Tel Aviv University, Prof. Meller recalls, he was unable to choose between physics (how to understand things better) and engineering (how to make things better). Today, as a world-class scientist with active labs both at Technion and Boston University, he knows that both are critical. "We live in extremely exciting times with respect to how science is to be done," says Prof. Meller, who has nine patents to his name, seven of which are already licensed.

As such, he is selecting just the right mix of multidisciplinary scientists for his research group in Israel. "We want to be both useful and exciting. The combination of basic and applied science makes the experience of research much more enriching and interesting. Students from the biophysics side will always be challenged by the engineers... who know they can do it better. When an engineer presents a better method – for example, for reading an RNA transcript, the scientist will challenge him with 'where is the question? Is it worthwhile pursuing?' I really enjoy these kind of multidisciplinary intellectual interactions – a positive tension – among colleagues in the same group."



Prof. Amit Meller, Faculty of Biomedical Engineering and an RBNI member recruited as part of the Nanomed Project.

New Light - Nano Matter

New RBNI recruit Assis. Prof. Guy Bartal at the Faculty of Electrical Engineering is unraveling the mysteries of light at the nanoscale. Light, as any other electro-magnetic waves, is subjected to fundamental physical limit: it cannot be focused, imaged or manipulated at length-scales that are smaller than its wavelength. Namely, imaging of nano-scale objects such as viruses or molecules with real-time optical microscopy is impossible, irrespective of how good is your microscope's lens. Likewise, focusing optical energy to such small scale for lithography or spectroscopy applications is also inhibited owing to the aforementioned restriction.

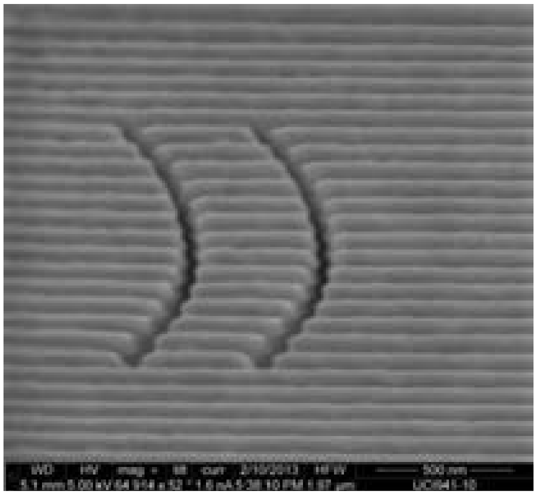
Assis. Prof. Bartal's research aims to explore and reveal the physics underlying sub-wavelength light phenomena at the nano-scale and to utilize it for novel devices and applications in super-resolution imaging, focusing, spectroscopy and optical communication.

His research field - known as plasmonics and artificial materials (metamaterials) – represents an innovative way to channel Electro-Magnetic waves in dimensions smaller than their wavelength, overcoming the limits of diffraction, by coupling them to the free electrons oscillation in the metal. This phenomenon is named 'surface plasmons' and serves as the building block for metamaterials with extraordinary optical properties as well as new class of nano-scale devices, such as nano-lasers and nano-imaging systems.

"I was happy to see that the Technion was well prepared to receive new faculty," said Assis. Prof. Bartal, on his return from Berkeley after his 4-year post-doctoral term in a leading group in the field.

"With the generous support of RBNI, I was able to set up a state-of-the-art optical lab just the way I imagined it."

Assis. Prof. Bartal's research comprises both experimental and theoretical science including micro and nano-electronic tools for sample fabrication, high power pulsed lasers as well as a near-field scanning optical microscope (NSOM) for characterization together with modeling and simulations. "This equipment is very expensive and the money invested in my lab is not just a little amount of money," says Assis. Prof. Bartal.



Coupling light to a nano-scale system: the light is injected, the curve slits into a nano-scale metallic grating, where it is being manipulated by the smaller-than-wavelength periodicity and plasmonic effects.

In the clean room

Assis. Prof. Guy Bartal, next to one of the nano-fabrication tools that are used to construct artificial materials (Metamaterials).

Assis. Prof. Bartal makes a broad use of RBNI infrastructure facilities to fabricate and characterize the samples used in his research. The facilities in use by Assis. Prof. Bartal include The Zisapel Nanoelectronics Center (MNFU), The Joint GTEP & RBNI Technion Photovoltaic Laboratory, which Assis. Prof. Bartal supervises and the Electron Microscopy Center.

She's got to have it

"There is a sense of pride in saying I'm from Israel and it's a science nation, a high-tech nation. People everywhere know the name Technion now."

At the front line of research on how light works through the nano dimension, new faculty member Assis. Prof. Lilac Amirav is manipulating the tiniest dimensions with the mission of making a global impact – opening future methods for energy conversion.

She looks too young to be a fully-fledged faculty member and world class scientist. Assis. Prof. Amirav grew up in Israel and has long had a passion for sustainability and green issues. "As a child I was always exposed to chemistry and environmental issues," she says. Assis. Prof. Amirav finished her first degree at Tel Aviv University when she was only 18. After serving as a chemist in the army, she went on to do her Ph.D. with Prof. Efrat Lifshitz. After a successful Post-Doctoral term in Berkeley, she was set to come home to Israel.

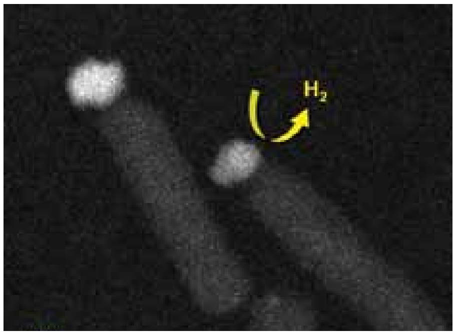
"As a graduate student, I developed a new method for the production of semiconductor nanoparticles. It excited the scientific community, but I couldn't see immediate implications for mankind. The thing about science is that you spend a lot of time and mental energy, constantly thinking about what you do. It is part of you and you are part of it. I enjoy very much the everyday routine work, and those ten percent of experiments that succeed make it all worthwhile. I know we are working towards something really important. If you just think about the problems that we have to face as humankind over the next 25 years and make a list, you will talk about war, hunger, pollution, clean water. Of all these things, energy is probably the most important of all, because if you solve the energy crisis, you impact everything," says Assis. Prof. Amirav.

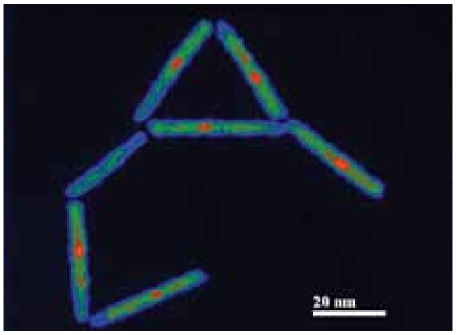
Assis. Prof. Amirav is particularly researching colloidal inorganic nanocrystals which represent a class of material building blocks, with tunable fundamental properties, and with chemical flexibility. Simple solution-phase chemical synthesis produces nanostructures of well-defined size, shape, and composition, which means scientists can rationally design innovative nanoparticles and construct sophisticated hetero-structures and hybrid systems that are tailored in a predictable manner for a particular demand.

The laboratory's cutting-edge synthetic effort is combined with fundamental research focused, on the dynamics and mechanism of photo-induced charge transfer processes, across the different components of the photo-catalyst system, and further into the solution. Emphasis is given to single particle, in-situ measurements. "Photocatalysis – taking light and converting it into matter – is really like using a magic wand," says Assis. Prof. Amirav.

Awareness of the consequences of the energy crisis, global warming and fossil fuel depletion is a driving force behind Assis. Prof. Amirav's determination to pursue excellence in science. "In colloidal photosynthesis, we can control the size of the particles, and that is a key that means we can tune the band gap and most of the properties of a nanoparticle. We are reaching that point where we can create almost everything that we can draw on paper – it's pretty remarkable. It opens the doors of creativity, and it also means we can stop playing and actually design something for a particular task. We are now trying to create materials that will translate sun energy into chemical reaction – direct solar-to-fuel conversions."

Why did Assis. Prof. Amirav choose to return to Technion? "Have you seen RBNI? Have you seen the research facilities we have here? This really opens the possibility for collaboration. It really is a wonderful place to be. My research is highly multidisciplinary, which means I need my lab as well as all those user facilities. Here you have everything you could imagine: the best TEM, clean rooms, microscopes, and the best pool of students."





Top: High-angle annular dark-field STEM micrograph of multi-component nanoheterostructure photocatalysts composed of a Pt-tipped CdS rod (20 nm long) with an embedded CdSe seed. In such system holes are confined to the CdSe while electrons are transferred to the Pt and are thus separated from the holes over three different components, and by a tunable physical length.

Bottom: High-angle annular dark-field image (rendered as a pseudo-color map) of CdSe@CdS seeded rods.

Assis. Prof. Lilac Amirav, Faculty of Chemistry and an RBNI member.

Nanosteps

"We think like physicists but we study biology. It's a very multidisciplinary approach and that means we need multidisciplinary facilities."

"We think like physicists but we study biology. It's a very interdisciplinary approach and that means we need multidisciplinary facilities," says Assis. Prof. Ariel Kaplan from the Faculty of Biology.

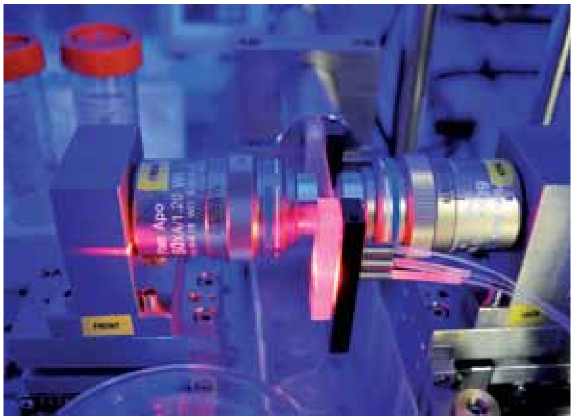
The difference between single-molecule biophysics and classic approaches to study cellular life, says Assis. Prof. Ariel Kaplan, is like the difference between observing the general movement of a herd of animals, and having the opportunity to look at each one close up, defining gender, age, and the way in which the animal walks, stands, sleeps and feeds.

"We study biological systems, looking at one single biological entity at a time," explains Assis. Prof. Kaplan, formerly of the University of California, Berkely. At the Kaplan Lab, mechanical forces in Biology are examined with the precision of a physicist, in particular, the function of the nucleic-acids processing machinery. On one side, the lab develops experimental setups that can apply mechanical forces on biological molecules and complexes, directly measuring molecular movements as small as Angstroms. On the other side, they use these instruments to study the machine-like function of polymerases, helicases and translocases.

"As opposed to the classical biologist or chemist that would have a test tube with millions and millions of copies of the same molecule or protein working, we build systems in which we look at a single molecule," explains Assis. Prof. Kaplan, describing the difference between single molecule biophysics and more classic biological approaches to research. "At a football stadium, if you look at the crowd from far away, you are not able to see each individual, but you can see some general properties. You can see people moving; you can know the average color of the hair or of their shirts, but if you want to really study how a person moves or acts, it's not enough to look from far away at the average properties. If you can look closely, you can see that some of them are women and some men, some are children, and only if you get very close will you be able to see each one separately – see their motion, how they stand, how they sit, how they interact with each other."

"We use laser beams to trap very small spheres of polystyrene or silica in solution. In between two beads we attach our biological complex. By following the motion of these beads, we can measure the forces and motion of, for example, an enzyme on DNA. We want to do this with enough resolution to detect the basic steps in the enzyme movement."

The basic scientific revelations of the physics of the cell will have implications. "One of the motors we work with, is an enzyme that belongs to the HIV virus," says Assis. Prof. Kaplan. "We are using these very technological methods to completely understand the enzyme's cycle, and all the things it needs to do to take one step."



A different approach to Biology: Researchers in Assis. Prof. Ariel Kaplan's lab use laser fields to apply mechanical forces on single biological molecules and complex, and measure their nanometer-scale movements.

Assis. Prof. Ariel Kaplan, Faculty of Biology and an RBNI member.

Sunlight reclaimed

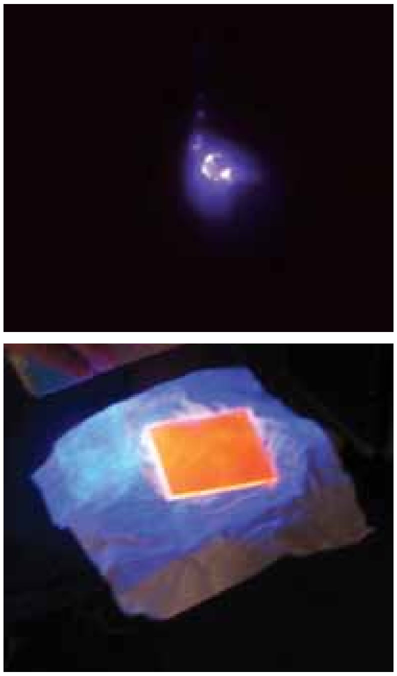
"Between the simplicity of silicon and the broad spectrum of sunlight falls the innovation."

On the one hand we have sunlight – an infinite source of energy – with a broad spectrum. On the other, we have silicon – an abundant material made from sand and the front-runner as the material most likely to be used in photovoltaic cells in solar energy panels. Between the simplicity of silicon and the broad spectrum of sunlight falls the innovation.

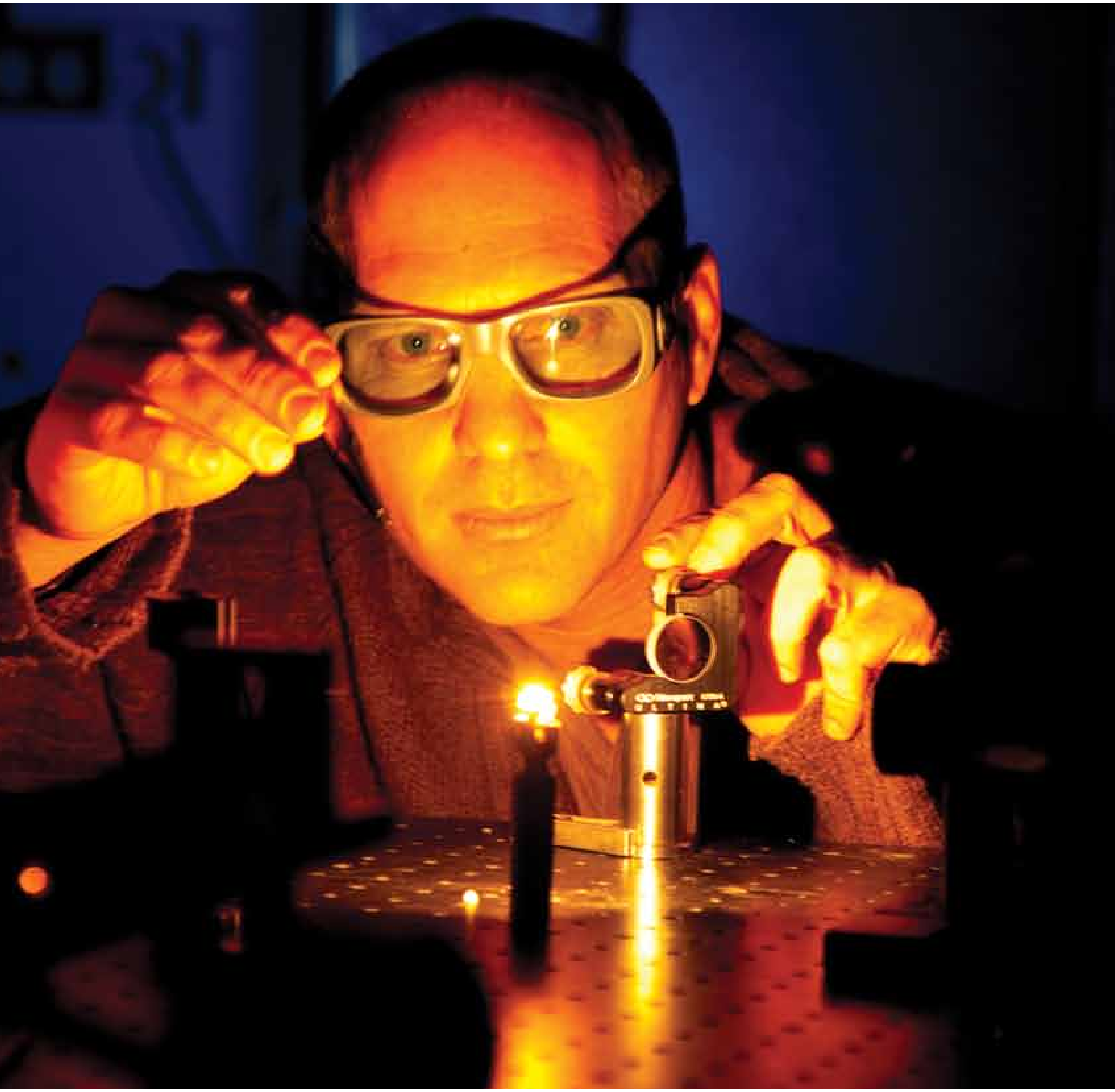
As oil reserves deplete, and energy prices rise, solar power is emerging as an essential source of clean, affordable energy. The scientific search-lights are on for new discoveries that could make solar energy competitive to fossil fuels.

RBNI new recruit, Assis. Prof. Carmel Rotschild, who arrived in August 2011 at the Faculty of Mechanical Engineering from M.I.T., is aiming to do just that. His dream is to increase the efficiency of photovoltaics by around 20 percent, by developing efficient appliances to convert the lost rays of the sun that silicon is unable to process. This involves the fusion (or up conversion) of infrared solar radiation to make that power accessible to silicon, and the fission (or down conversion) of radiation in the blue range to near infrared radiation, which could double the quantum efficiency of photovoltaics. The highly multidisciplinary approach includes the design and fabrication of nano-scale optical materials within an optical cavity, and Assis. Prof. Rotschild and his multidisciplinary team draws on expertise in nonlinear optics, material engineering, and energy transfer in molecules.

"What I'm doing in my research is combining nonlinear optics and luminescent solar concentrators to build accessories for photovoltaics," explains Assis. Prof. Rotschild. "My vision is to increase efficiency by 20 percent for a given photovoltaic cell. The main issue that limits efficiency, is the mismatch between the broad solar spectrum, and the narrow spectral response of photovoltaics. For example: silicon is very effective at one micron wavelength, but light with a longer wavelength cannot be converted into electricity by silicon solar cells. It would be nice to look at nonlinear optics as a toolbox for converting inefficient parts of the solar spectrum into emissions where solar panels can be more efficient."



Top: Entropy driven ten-fold up-conversion.
Bottom: Luminescence of a solar concentrator.



Assis. Prof. Carmel Rotschild, Faculty of Mechanical Engineering and an RBNI member.

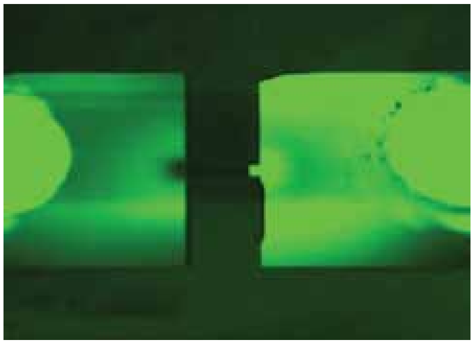
Lab on a chip

Miniaturized micro- and nano-fluidic based diagnostic chips, micro-heat exchangers, cell separation, these are just some applications unfolding at the Faculty of Mechanical Engineering. Assis. Prof. Gilad Yossifon and his team at the Micro- and Nano-Fluidics Laboratory promises to transform membrane, interface and colloid sciences in the service of energy, medicine, and the environment.

With the advent of nanofabrication technology, says Assis. Prof. Yossifon, scientists can now produce well-controlled nanofluidic structures. "My specialty is in electrokinetics, i.e., the use of electric fields to impart a force on liquids and particles (e.g. cells, biomolecules), which promises to be the technique of choice for many portable and miniaturized micro-and nano-fluidic based devices, and will become increasingly important for many future nanoscale materials with large surface-to-volume ratio," he says.

As a source of expertise on nanofluidics, Assis. Prof. Yossifon attracts graduate students from the Russell Berrie Nanotechnology Institute (RBNI) who find diverse applications for the Nano know-how, from single-cell- and molecule (e.g. DNA) manipulation, lab-on-a-chip, integrated nanofluidic circuits, desalination on-a-chip, and energy conversion.

"Technion gives someone like me the tools to do truly multidisciplinary research," he says. Raised in Beersheva, Assis. Prof. Yossifon whose recruitment to Technion was made possible by the Edmond J. Safra Philanthropic Foundation, is a second generation of Technion mechanical engineering graduate. "I understood very early on that I was attracted to engineering, through the living example in the house. You get it by diffusion..."



Top: A typical nanofluidic chip fabricated using photolithography techniques.

Bottom: Formation of ionic depletion and enrichment zones in a microchannel-nanochannel system.

Assis. Prof. Gilad Yossifon, Faculty of Mechanical Engineering and an RBNI member.

Prof. Yoav Livney and his team.

Food for All

Nanocapsules developed by Technion researchers from natural materials can also be used by the pharmaceutical industry – in the protection of medicines in the stomach and their release in the intestine, as well as for targeting cancerous tumors.

Technion researchers have created nanocapsules that are based on natural food components, and trapped in them vitamins and nutraceuticals (health-enhancing micronutrients) that do not dissolve well in water. The nanocapsules can be added to clear beverages, thus increasing their health benefits without clouding them.

RBNI Prof. Yoav Livney and his team in the Faculty of Biotechnology and Food Engineering used the Maillard reaction to create nanocapsules based on the protein–polysaccharide conjugates. This natural reaction, which is the cause of the browning of food during baking and cooking, was used in the past in the creation of emulsions and microcapsules for nutrients that do not dissolve in water, but the problem with the existing methods is that the capsules obtained were large, so that they clouded the liquid they were added to.

To overcome this problem Prof. Livney and his team conjugated maltodextrin, a product of the breakdown of starch into casein, milk protein, in a controlled process. The conjugated molecules (conjugates) underwent spontaneous self-assembly into capsules of nanometric dimensions. These nanocapsules are so small, that the beverages they were added to remained clear.

In the next stage, the researchers trapped in the nanocapsules vitamin D (large parts of the population suffer from vitamin D deficiency, which could cause rickets in children and many other health disorders in adults). The research team found that the Nanocapsules protect the vitamins "packed" in them. "They protected the vitamin D from degrading in an acidic environment, and during its refrigerated shelf-life," says Prof. Livney.

Another important material called EGCG (epigallocatechin gallate), that is found in green tea and that is considered to inhibit many diseases, among them are neurodegenerative diseases, cardiovascular diseases and cancer, was also significantly protected by the conjugates throughout its shelf-life.

The researchers also followed the release of the nutrients from the nanocapsules under simulated digestion conditions. They discovered that the nanocapsules succeeded in keeping the nutrients trapped in them, and in protecting them under stomach conditions. Prof. Livney believes that the enzymes in the small intestine will break the polysaccharide-protein envelope down easily, allowing the absorption of the nutritional nano-cargo at the desired location, in the small intestine.

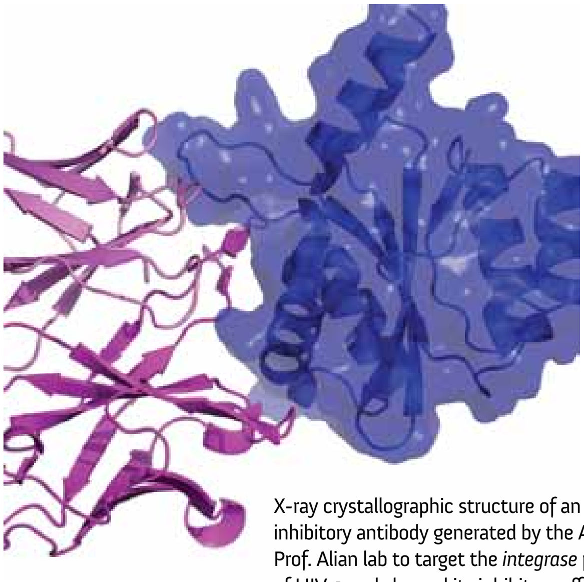
In the future Prof. Livney plans to "research the overall release profile of nutraceuticals through simulated digestion, and later to examine their bioavailability in vivo in clinical trials." He adds that "we also intend to investigate the encapsulation by this method of other bio-active components, such as anti-cancer medicines."

Another team headed by Prof. Livney is currently developing the next generation of polysaccharide-protein conjugate-based on nanocapsules, which are aimed at target-oriented delivery of medicines in the body, marking the location of cancerous tumors and destroying them.

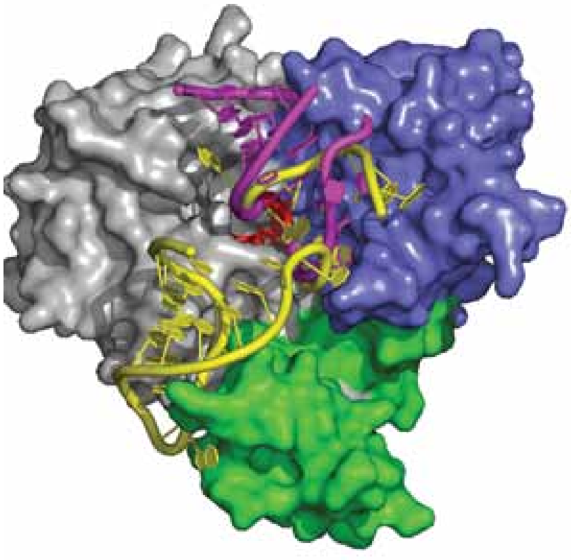
Prior to becoming a faculty member in the Technion's Faculty of Biotechnology and Food Engineering, Prof. Livney was involved in the development of "Gamadim", "Ski" and "Symphony", as part of his work as the product development manager of the cheese business unit at "Strauss".

Prof. Livney is currently the Norman Seiden Nanoscience & Nanotechnology graduate program coordinator.

Assis. Prof. Akram Alian, Faculty of Biology and an RBNI member. Assis. Prof. Alian was recruited as part of the NanoMed Project.



X-ray crystallographic structure of an inhibitory antibody generated by the Assis. Prof. Alian lab to target the *integrase* protein of HIV-1 and showed its inhibitory effect on HIV replication.



Structural basis of substrate recognition by RNA-enzymes revealing critical structural-determinants that underlines the molecular mechanism of recognition. High-resolution X-ray structure determined by Assis. Prof. Alian using X-ray crystallography.inhibitory effect on HIV replication.

"Seeing" is believing

It sounds like modern warfare, and indeed, even when aiming to outsmart a killer virus on a scale of about 100 nanometers, the latest technology makes all the difference. One of the deep passions behind Assis. Prof. Alian pioneering crystallographic work in the Technion is a desire to advance treatments for HIV, the causative agent of AIDS.

Scientists in Assis. Prof. Alian's lab investigate the general principles of how aggressive virus lock into the genetic resources of a patient, and how to prevent them from doing this. "It is MUST to learn about the critical interactions and the mechanisms of resistance," says Assis. Prof. Alian. The team is taking a sharp look at pathogen-host interaction and how the HIV virus literally hijacks the machinery of the host cell to replicate itself, and how it escapes the immune system. "We are hoping to determine the structures of key interacting molecules, and develop new intervening strategies and drugs that prevent their interaction. We also want to understand the mechanism of emergent resistance in the proteins of this virus."

Current drugs for HIV bind viral proteins - and yet it continues to mutate and regenerate. Assis. Prof. Alian's team is working on a protein discovered in 2004 - intrinsic immunity APOBEC3G. This protein attacks the genome of HIV and causes hypermutation that leads to an abortive replication cycle for HIV. However, HIV expresses a protein that destroys APOBEC, so the Assis. Prof. Alian's group wants to understand this process better so that it can be blocked.

Assis. Prof. Alian uses the powerful X-ray crystallography technique for resolving these objects at atomic resolution. The latest and most state-of-the-art tools of X-ray crystallography are now housed in the Emerson Family Building for Life Sciences. The *Technion Center for Structural Biology* (TCSB), with the most advanced X-ray diffractometer and robotics, will provide structural biologists with 21st century equipment to support their research *in-house* rather than remotely as done before.

Nano
in Action

Instilling in Technion graduates the dicipline, skills, knowledge and tools necessary to pioneer nano innovation in Israel and the world is a key objective at RBNI.

The Norman Seiden Multidisciplinary Graduate Program in Nanoscience and Nanotechnology was launched in October 2005 and expanded in October 2006 to include a Ph.D. program. This “first of a kind” program reflects a genuine effort to give an elite group of students a "renaissance-type" of education. It is a vital part of RBNI’s vision to position Technion and the State of Israel at the forefront of cutting-edge research and development in the innovative fields of nanotechnology.

The science involving nanometric systems and the technology derived from them involves the convergence of know-how from numerous fields. The Program offers a core curriculum exposing students to the varied fields of nano science, and endows them with the necessary knowledge in the life sciences (biology and medicine), the exact sciences (chemistry and physics), and engineering (electrical, materials, chemical, mechanical, biomedical, biotechnology and more).

The broad education requires five semesters for M.Sc. compared with the usual four, with the first two semesters mostly devoted to filling gaps in the required background. Acceptance into the program is determined by a candidate’s personal interview with the program committee. Candidates are also encouraged to find a research advisor or two, to preferably enhance multidisciplinary research.

The Norman Seiden Multidisciplinary Graduate Program in Nanoscience & Nanotechnology

RBNI 2012 scholarships and Prizes

From left to right: Prof. Oded Shmueli, Executive Vice president for research, Prof. Hillel Pratt, Dean, The Irwin and Joan Jacobs Graduate school, Mr. Norman Seiden, The Russell Berrie Foundation trustee, first prize winner PhD Student Lior Kornblum from the Materials Science & Engineering faculty and Prof. Ishi Talmon, former RBNI Director.

Due to the diverse academic backgrounds of graduates entering the program, a personalized course of study is designed for each candidate.

The unique Norman Seiden Multidisciplinary Graduate Program in Nanoscience and Nanotechnology has grown from 6 students in its first year to 86 students in the present semester. The Program has started to attract international students. 26 students have graduated since the launch of the program (21 M.Sc. and 5 Ph.D.).

RBNI support related to the graduate program includes:

- Funding training of graduate students in operating capital equipment
- Subsidizing travel expenses of students to nano-related conferences
- Supporting nano conferences held at Technion
- Hosting academic guests of the Institute
- Granting excellence scholarships and prizes

Other dedicated educational activities open to the entire RBNI community include a seminar series; the bi-annual RBNI Winter School and Fall Symposium; infrastructure equipment training sessions for graduate students; student participation in international conferences; hosting international nano conferences and visiting professors at Technion; developing youth education programs; and scholarships for excellence.

THE LEGENDARY RBNI winter school

Prof. Avi Minsky - Weizmann Institute,
RBNI 2012 winter school.

Think Nano,
Think together.

The RBNI winter schools in nanoscience and nanotechnology have become a major event attracting participants from around the world. Following the success of the 2008 winter school, a follow up event took place in February 2010 in Ein Gedi near the dead sea. For the third winter school, RBNI moved in 2012 to Kibbutz Hagoshrim. This school focused on two major RBNI research areas: imaging and self aggregation. Each of the three schools brought together 15 internationally renowned experts and some 140 graduate students from Technion and other Israeli universities.

Biannual fall symposia have been taking place since 2008. This is an internal Technion event in which about 100 graduate students and 20-25 faculty members engage in a two days intense scientific conference. The latest symposium took place in December 2012 in Kibbutz Tzuba near Jerusalem.

Prof. Meir Orenstein, Faculty of Electrical Engineering and head of the FTA project at the 3rd CTO's Forum, Jan 2012.

Strengthening the contacts with industry is one of RBNI's highest priorities. As it is generic and multidisciplinary, Nanotechnology and science poses unique challenges in commercialization. To address this need, RBNI initiated dozens of meetings with industry, including open days with companies such as Intel, IBM, Elbit, Rafael, Israel Aircraft Industry (IAI), and Applied Materials. In 2010, RBNI initiated a series of short workshops to inform people from industry on the wide spectrum of infrastructure capabilities on campus, under the auspices of the RBNI.

Acting as the Industry-Academia Liaison, Dr. Elyakim Kassel works as "the interface" between industry and RBNI, helping industry identify contacts within the Technion to solve problems or suggest use of particular infrastructure; and to assist in identifying research projects that could potentially lead to industrial processes or products. Dr. Kassel is also available to RBNI faculty for consultation, and in the identification of projects for commercialization.

53 research groups from Industry used RBNI infrastructure in 2012 and 188 cooperation projects with industry were launched since 2005, such as Magneton, Kamin, Nufar, participation in MAGNET consortia, participation in defense projects and more.

In 2011, RBNI launched the RBNI-Industry CTO's forum with the goal to establish a continuous dialogue between the Israeli industry and the Technion Nano community and with the target to strengthen research and development collaboration. Three CTO's forum took place so far.

Collaborating with Industry

"Nanotechnology is the base technology of an industrial revolution in the 21st century. Those who control nanotechnology will lead the industry."

- Michiharu Nakamura, Executive VP at Hitachi

Dr. Yael Dror, R&D Manager.

Nanospun: Fibers of the Future

"Success is all about people," says Ohad Ben Dror, founder of NanoSpun, which after two years of intense groundwork was incorporated as a company in April of 2011. "You need a strong team that can work together well and drive the company to success."

Backed by prominent investors, the versatile, hollow nanofiber innovation first emerged from the laboratory of RBNI Prof. Eyal Zussman. Unique and cost-effective in their fabrication, the fibers can be tailored for applications in cleantech, medical devices, solar energy, textiles and packaging. An example is shown here by Dr. Yael Dror, a researcher working with Prof. Eyal Zussman.

At the forefront of the young company's present agenda are applications in cleantech, where there is a global demand for advanced and efficient systems for water and wastewater filtration and purification.

Based in the Gutwirth Science Park in Technion City, NanoSpun has already won world acclaim. In 2011, in Italy, the race was on at the Nano/Polymer Challenge as nano entrepreneurs from across the world presented their innovative nanotechnologies, business plans, and long-term vision to an international panel of judges. NanoSpun won the day, with first place in the Polymer category and a prize of 300,000 euros.

Prof. Dror Seliktar, Biomedical Engineering.

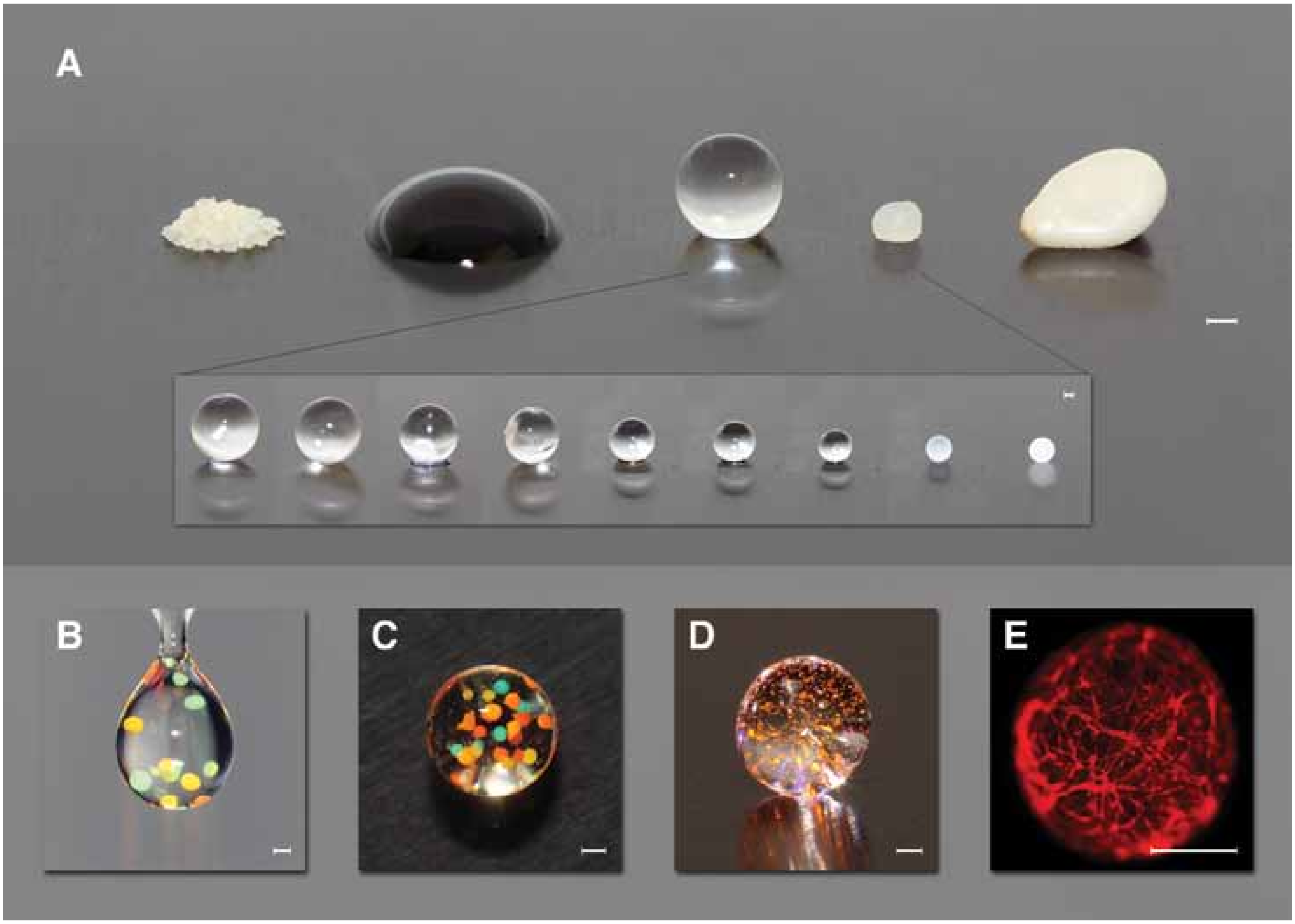
Regentis Biomaterials

“If you get a traumatic injury to the knee, very few treatment options are available,” says RBNI Prof. Dror Seliktar of the department of Biomedical Engineering, giving an example of one use of the innovative biodegradable hydrogels being marketed by a company he founded, Regentis Biomaterials.

“A replacement knee may eventually be required if the progression of the injury is not contained. If you are injured at age 25, it can be pretty daunting to know that at age 55 you may need a knee replacement. We can alleviate the progressive degeneration with a therapy that actually helps repair the tissue – intervening early on, and preventing further degeneration.”

Established in 2004, Regentis Biomaterials is commercializing innovative biodegradable hydrogels for the local repair of damaged cartilage and bone. The platform technology is a family of hydrogels called Gelrin™. These gels can be injected or applied to a specific local site and offer beneficial properties for the local repair of damaged tissue such as cartilage and bone.

“The company is unique in Israel, and also in the world,” says Prof. Seliktar. Regentis recently secured an additional investment of $10 million to establish its European presence and to expand its ongoing clinical efforts of Gelrin™.



This above-pictured research was implemented at Regentis Biomaterials, and recently published in *Nature*:

Hydrogels can be cast into practically any shape, size and form as described in figures A-E

(A) Polymer powder *(far left)* added to a drop of water *(left)* and crosslinked, results in the formation of a hydrogel *(center)*. Even if the hydrogel network is dehydrated *(right),* it still retains its overall shape. A sesame seed *(far right)* is shown for scale.

The stages of the dehydration process are shown from left to right.

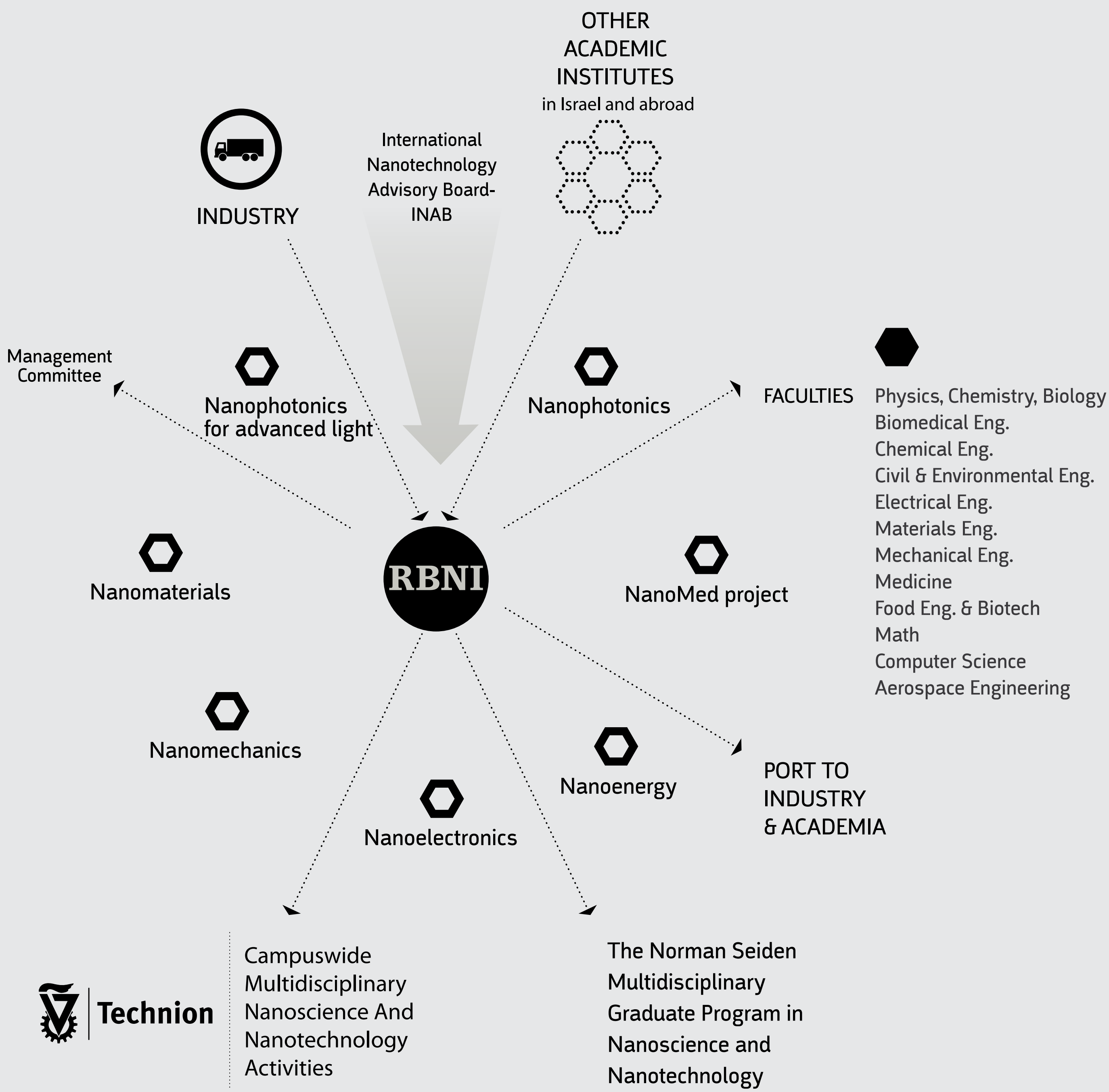
(B) Waterborne microgels in suspension containing several different immobilized molecules (color-coded) are shown in a single drop of water to highlight the possibilities for injectable hydrogel drug delivery.

(C) A transparent microgel containing smaller color-coded microgels is shown to highlight new "gel-in-gel" experimental tools for biomedical scientists.

(D) A microgel encapsulating fluorescently labeled cells is shown to highlight potential uses in cell delivery for tissue regeneration.

(E) Encapsulated fibroblast cells thrive in a biocompatible microgel, illustrating how these highly compatible milieus for studying cell behavior may one day replace conventional cell culture paradigms in cancer research, stem cell and development biology. Scale bars represent 500 micrometers.

RBNI Nano cluster



Nanoscience & Nanotechnology at Technion

Nano-Photonics

- Quantum dot detectors and emitters
- Single and entangled photon optics
- Nano plasminics
- Nonlinear optics and high harmonic generation
- Organic light emitting devices
- Photonic crystals
- Atomic clocks

Nanophotonics for advanced light detection and sensing

- Advanced light detection
- Super resolution imaging
- Inspection
- Smart sensors
- Energy conversion
- Enhanced light emission from nano scale sources

Nanoenergy

Alternative fuels
- Non-carbon fuels
- Biomass-based fuels
- Hydrogen technology

Energy storage and conversion
- Energy storage
- Fuel cell technologies

Renewable energy
- Photovoltaics
- Wind power
- Solar thermal energy

Energy conservation
- Energy saving measures
- Efficient buildings

Nano-Materials

- Interfaces in electronic circuits
- Atomistic simulations of Nano-materials
- Nano-porous ceramics
- Bio-compatible materials
- Polymer composites with Nano-materials
- Nano & molecular magnets
- Nano-diamond films
- Carbon & semiconductor Nano-wires
- Advanced materials characterization
- Soft matter

Nano-Electronics

- Nano-electronics
- Quantum dot & molecular devices
- Carbon, semiconductor, & oxide Nanostructures
- Organic and bio-organic electronics
- Compound semiconductors for fast electronics
- Superconducting devices
- Sensors
- Fuel cells

Nano-Mechanics & fluidics

- Nano-rheology in still & living matter
- MEMS & NEMS
- Mechanical properties at the Nano-scale
- Flow & ion transport in Nano-channels
- Mechanics of cells & cell motility

The NanoMed project

- Imaging
- Medical devices
- Nano-capsules for drug delivery
- Nanotechnology for food industry
- Scaffolds for tissue engineering
- Bio-organic composites
- Electronics-biomolecules interface
- Medical diagnostics
- Biomolecular computing
- Bio-mechanics at the Nanoscale
- Nano-optics and electronics on neural structures
- Bio-sensors

"Truly, Israel is going to make it because of what we are doing here at Technion... because here is the future..."

-The late Mr. Russell Berrie during a visit at the Technion

Inspired by RBNI and the transformation of science and technology heralded by the nano-revolution, world-renowned architect Dr. Santiago Calatrava designed a giant obelisk that now signals the heart of the Technion campus.

Dr. Calatrava contibuted the detailed designs of the impressive kinetic sculpture, and the Russell Berrie Foundation underwrote the creation of the obelisk.

The obelisk, which rises to a height of 28 meters (100 feet), was erected on the main boulevard in the heart of the campus. The 28-meter high kinetic sculpture is composed of 224 steel ribs rotating on an axis. The movement (which is illuminated at night) creates a feeling of a synodic wave and the obelisk appears to "breathe."

FACULTY DIRECTORY

NANOELECTRONICS

FACULTY MEMBER	FACULTY	RESEARCH
Adler Joan	Physics	Atomistic simulations of Nanodiamond and Nanotubes.
Auslander Ophir	Physics	Nanoscale imaging and manipulation in semiconducting and superconducting systems and devices.
Bahir Gad	Electrical Engineering	Quantum dot detectors.
Buks Eyal	Electrical Engineering	NEMS and Nanoelectronics.
Eichen Yoav	Chemistry	Preparation and characterization of junctions and networks of oligonucleotide-conjugated polymer and polypeptide-conjugate polymer hybrids for Nanoelectronics.
Eisenstein Gadi	Electrical Engineering	Quantum dot based lasers and amplifiers, nonlinear photonic crystals, nano scale electronic devices, chip-scale atomic clocks.
Eizenberg Moshe	Materials Science and Eng.	Silicon technology at the Nanoscale.
Elata David	Mechanical Engineering	MEMS, tensile test systems.
Gershoni David	Physics	Optical and electronic properties of quantum wells, wires and quantum dots. Short-pulse lasers and high spatial resolution optics for low light level spectroscopy and sub picosecond time resolved spectroscopy.
Ginosar Ran	Electrical Engineering	Neuroelectronic VLSI systems: Chips that interact with neurons for brain research using large neuronal network and for computer-controlled brain implants to treat neural diseases.
Haick Hossam	Chemical Engineering	Nanomaterial-based artificial olfactory systems and (opto)electronic devices.
Hoffman Alon	Chemistry	Growth of Nanodiamond films, examination by HRSEM, HRTEM, SPM, NEXAFS, and electron spectroscopy.
Kaftory Menahem	Chemistry	Supramolecular chemistry, Nanomagnets, quantum tunneling of magnetization, organic-based magnets.
Leviatan Yehuda	Electrical Engineering	Electromagnetic modeling, photonic crystal structures, photonic crystal fibers, plasmonic waveguides, near field microscopy.
Lotan Noah	Biomedical Engineering	Biomedical/biotechnological use of submicron size particulate materials.
Maniv Tsofar	Chemistry	Quantum and geometric effects of inorganic Nanotubes and orbit motion effects in semiconductor Nanocrystals.
Meller Amit	Biomedical Engineering	Elucidating the physics of biomolecules in confined spaces and under strong electromagnetic fields.
Peskin Uri	Chemistry	Electron transmission through single molecules and supra-molecular assemblies, combined experimental and theoretical investigation.
Ritter Dan	Electrical Engineering	InP based nano wires for emitters and detectors and nano Scaled Indium Phosphide Based Transistors for Terahertz Applications.
Salzman Joseph	Electrical Engineering	Coupled Nanocavities in photonic crystals for quantum information technology.
Sivan Uri	Physics	Selection of antibodies and peptides against electronic materials, electrical control over bioreactions, bioassembly of electronic devices.
Tessler Nir	Electrical Engineering	Junctions and networks of oligonucleotide-conjugated polymer and polypeptide-conjugate polymer hybrids, organic-inorganic Nanocomposites for semiconducting polymers and optoelectronic devices.
Yaish Yuval	Electrical Engineering	Electrical and mechanical characterization of one dimensional structures, like carbon Nanotubes and silicon Nanowires.

NANO PHOTONICS

FACULTY MEMBER	FACULTY	RESEARCH
Amitay Zohar	Chemistry	Interaction of molecular systems with femtosecond laser pulses and the observation and control of coherent molecular dynamics.
Bartal Guy	Electrical Engineering	Nano-Photonics, Metamaterials, Metal optics, Nanolasers.
Cohen Oren	Physics	Attosecond science, Nonlinear optics, Laser-driven x-rays, Solitons, Lens-less imaging.
Ehrenfreund Eitan	Physics	Lasers and high spatial resolution optics, for low light level spectroscopy and sub picosecond time resolved spectroscopy.
Finkman Eliezer	Electrical Engineering	Quantum dot detectors.
Fischer Baruch	Electrical Engineering	Nanooptical structures, Nano via ultra-short light pulses femto-sec and atto-sec.
Gershoni David	Physics	Optical and electronic properties of quantum wells, wires and quantum dots. Short-pulse lasers and high spatial resolution optics for low light level spectroscopy and sub picosecond time resolved spectroscopy.
Hasman Erez	Mechanical Engineering	Nanophotonics, Nanoscale structures, plasmonic Nano-devices, Nanocavities, near-field optics, near-field thermal excitation.
Eisenstein Gadi	Electrical Engineering	Quantum dot based lasers and amplifiers, nonlinear photonic crystals, nano scale electronic devices, chip-scale atomic clocks.

*Researchers may appear in more than one category

FACULTY DIRECTORY

FACULTY MEMBER	FACULTY	RESEARCH
Horowitz Moshe	Electrical Engineering	Nanooptical structures, Inverse Scattering Theory, Periodic optical Nanostructures, Ultrashort pulses.
Kalish Rafi	Electrical Engineering	Nano diamond, Single optical centers in diamond (NV) for quantum information processing.
Kaplan Ariel	Biology	Single-molecule biophysics, Force spectroscopy, Molecular motors.
Kurant Estee	Medicine	Cell biology, Developmental biology, Genetics.
Landesberg Amir	Biomedical Engineering	Biophysics of the muscle molecular motor, biological control of sub-cellular Nanosystems for therapeutic modalities.
Levitan Yehuda	Electrical Engineering	Electromagnetic modeling, photonic crystal structures, photonic crystal fibers, plasmonic waveguides, near field microscopy.
Lifshitz Efrat	Chemistry	Synthesis and optical characterization of unique semiconductor Nanocrystals: core-shell structures, quantum-dots, quantum wells, single dots and self assembly. Magnetooptical spectroscopy.
Orenstein Meir	Electrical Engineering	Nanoplasmonic circuitry, quantum information processing, optical Nanocavities and sources.
Ribak Erez	Physics	Modelingand measuring Nano-optical structuresin the retina.
Ritter Dan	Electrical Engineering	InP based nano wires for emitters and detectors and nano Scaled Indium Phosphide Based Transistors for Terahertz Applications.
Salzman Joseph	Electrical Engineering	Coupled Nanocavities in photonic crystals for quantum information technology.
Schechter Israel	Chemistry	Chemical analysis of Nanoparticles using laser induced plasmas and laser induced fluorescence fluctuations.
Segev Mordechai	Physics and Solid State Institute	Nonlinear optics, photonics, quantum electronics, and nonlinear waves in photonic lattices.
Shamir Joseph	Electrical Engineering	Optical procedures for Nanometric feature structuring and measurements.
Speiser Shammai	Chemistry	Molecular scale logic gates.
Varenberg Michael	Mechanical Engineering	Tribology.
Yelin Dvir	Biomedical Engineering	Nanoparticled and ultrashort pulses for biomedical applications.

NANOMATERIALS & NANOPARTICLES

Adler Joan	Physics	Atomistic simulations of Nanodiamond and Nanotubes.
Altus Eli	Mechanical Engineering	Stochastically heterogeneous materials in Nanotechnology.
Amirav Lilac	Chemistry	Photocatalysis on the Nano scale and related photophysical and photochemical phenomena.
Amouyal Yaron	Materials Science and Eng.	Thermoelectric devices.
Apeloig Yitzhak	Chemistry	Reaction mechanisms and reactive intermediates in organosilicon and organic chemistry.
Auslander Ophir	Physics	Nanoscale imaging and manipulation in semiconducting and superconducting systems and devices.
Berger Shlomo	Materials Science and Eng.	Dielectric properties of Nanometer-sized particles.
Blank Aharon	Chemistry	Single spin spectroscopic detection and Nanometer scale imaging of paramagnetic defects in semiconductors.
Cohen Yachin	Chemical Engineering	Carbon-based materials, dispersion and processing of carbon Nanotubes for functional Nanocomposites, small-angle x-ray and neutron scattering.
Dosoretz Carlos	Environmental & Civil Eng.	Advanced waste water treatment and reuse: membrane filtration/bioreactor effluents desalination, biofouling, micro-pollutants.
Eichen Yoav	Chemistry	Preparation and characterization of junctions and networks of oligonucleotide-conjugated polymer and polypeptide-conjugate polymer hybrids for Nanoelectronics.
Eisen Moris S.	Chemistry	Synthesis of Nanomembranes for wastewater treatment, elastomeric polymers encapsulating Nanoparticles.
Eizenberg Moshe	Materials Science and Eng.	Silicon technology at the Nanoscale.
Elata David	Mechanical Engineering	MEMS, tensile test systems.
Etsion Izhak	Mechanical Engineering	Friction wear and lubrication on the Nanoscale.
Eyal Yehuda	Chemistry	Construction and characterization of ion track Nanomembranes.
Frey Gitti	Materials Science and Eng.	Design, synthesis and characterization of novel conjugated polymer/inorganic Nanocomposites for electronic devices. Coassembly of organic and inorganic precursors with molecular level control.
Gendelman Oleg	Mechanical Engineering	Heat transport in Nanosystems; Nanomechanics of polymer systems; mechanical and thermal properties of Nanostructured metals.
Gershoni David	Physics	Optical and electronic properties of quantum wells, wires and quantum dots. Short-pulse lasers and high spatial resolution optics for low light level spectroscopy and sub picosecond time resolved spectroscopy.
Grader Gideon	Chemical Engineering	Sol-gel processing of ceramic Nanomaterials: xerogels and aerogels, Nanosized catalysts, ceramic foams, Nanostructured PZT films, coatings.

*Researchers may appear in more than one category

FACULTY DIRECTORY

FACULTY MEMBER	FACULTY	RESEARCH
Haick Hossam	Chemical Engineering	Nanomaterial-based artificial olfactory systems and (opto)electronic devices.
Hoffman Alon	Chemistry	Growth of Nanodiamond films, examination by HRSEM, HRTEM, SPM, NEXAFS, and electron spectroscopy.
Kahn Itamar	Medicine	Identify biomarkers of progressive neurodegenerative conditions and basic organizing principles of large-scale neural systems. Using multi-scale imaging of neuralsystems.
Kaftory Menahem	Chemistry	Supramolecular chemistry, Nanomagnets, quantum tunneling of magnetization, organic-based magnets.
Kanigel Amit	Physics	Angle resolved phtoemission spectroscopy. Magnetic resonance. Strongly correlated electron systems and exotic superconductors. Nano-scale phase seperation in strongly correlated systems.
Kaplan Wayne .D.	Materials Science and Eng.	Ceramic-matrix Nanocomposites, atomistic structure and chemistry at interfaces, thermodynamics of interfaces, advanced electron microscopy for characterization.
Keren Amit	Physics	Magnetic quantum tunneling in molecular magnets.
Kolodney Eli	Chemistry	Fullerene based carbon Nano-stuctures, novel focused ion beams for Nano-processing and Nano-modification of surfaces, Ion beam induced synthesis of new materials, surface impact interactions using fullerene ion beams, secondary ion mass specrometry of ultra-thin (Nanoscale) biological, organic, inorganic and polymeric overlayers.
Levenberg Shulamit	Biomedical Engineering	Nano- and micro-manipulations of embryonic stem cell differentiation and 3D organization, Nanodesign of biopolymers for tissue engineering.
Lesmes Uri	Biotechnology & Food Eng.	Food Nanotechnology: Controlling lipid oxidation and food delivery systems by novel strategies of rationally designed food colloids and interfaces. Development of structured emulsions and other advanced formulations for food and biotechnological applications.
Lifshitz Efrat	Chemistry	Synthesis and optical characterization of unique semiconductor Nanocrystals: core-shell structures, quantum-dots, quantum wells, single dots and self assembly. Magnetooptical spectroscopy.
Lifshitz Shay	Materials Science and Eng.	Nanostructuring of silicon and semiconducting Nanowires by thermal CVD, energetic particle deposition.
Maayan Galia	Chemistry	Interactions between biomimetic oligomers and metal Nanoparticles.
Maniv Tsofar	Chemistry	Quantum and geometric effects of inorganic Nanotubes and orbit motion effects in semiconductor Nanocrystals.
Maayan Galia	Chemistry	Interactions between biomimetic oligomers and metal Nanoparticles.
Meller Amit	Biomedical Engineering	Elucidating the physics of biomolecules in confined spaces and under strong electromagnetic fields.
Mizrahi Joseph	Biomedical Engineering	Tissue engineering for articular cartilage.
Narkis Moshe	Chemical Engineering	Polymer composites with Nanoclay particles: impact resistance, heat distortion, water disorption, gas permeability and flame retardance.
Nepomnyashchy Alexander	Mathematics	Modeling development of quantum dots.
Novick-Cohen Amy	Mathematics	Grain boundaries and surface evolution.
Paz Yaron	Chemical Engineering	Utilizing organized organic monolayers, in particular self-assembled monolayers, in photocatalysis and microelectronics.
Pokroy Boaz	Materials Science and Eng.	Interactions between organic molecules and inorganic surfaces.
Polturak Emil	Physics	High temperature superconducting Nanostructures.
Rabkin Eugen	Materials Science and Eng.	Mechanical properties at the Nanoscale, thermodynamics and kinetics of bulk ultrafine grain materials.
Reznikov Michael	Physics	Nanomaterials and Nanoparticles.
Riess Ilan	Physics	Electrical properties of dense sintered ceramics, gas diffusion in porous ceramics, electrical properties of ultra thin ceramic layers.
Rittel Danny	Mechanical Engineering	Dynamic plasticity of Nanolayers, Analytycal and experimental aspects in Nanohardness testing, Failure at the Nanoscale.
Ritter Dan	Electrical Engineering	InP based nano wires for emitters and detectors and nano Scaled Indium Phosphide Based Transistors for Terahertz Applications.
Rothschild Avner	Materials Science and Eng.	Tailoring functional properties of Nanostructured electroceramic materials, in particular metal oxides, by controlling their crystal structure and chemistry, morphology, porosity, grain size and interface structure.
Schechter Israel	Chemistry	Chemical analysis of Nanoparticles using laser induced plasmas and laser induced fluorescence fluctuations.
Schmidt Asher	Chemistry	Solid state NMR studies of bio-macromolecules and materials.
Segal Ester	Biotechnology and Food Eng.	Multifunctional Nanomaterials for advanced applications, sensors and biosensors.
Semiat Raphael	Chemical Engineering	Nanoparticles, Nanocatalysts, colloids in desalination and modern membranes production based on Nanoparticles.
Sheintuch Moshe	Chemical Engineering	Diffusion and storage in Nanopores, multiscale analysis of catalytic kinetics, self-organized Nanopores.

FACULTY MEMBER	FACULTY	RESEARCH
Siegmann Arnon	Materials Science and Eng.	Polymers containing Nanocarbon black particles for electrical conductivity and chemicals sensing; polymer Nanocomposites; electrochromic systems.
Silverstein Michael	Materials Science and Eng.	Nanoporous materials for low-k dielectric and sensor applications.
Sivan Uri	Physics	Selection of antibodies and peptides against electronic materials, electrical control over bioreactions, bioassembly of electronic devices.
Srebnik Simcha	Chemical Engineering	Hierarchical modeling of molecular imprinting technology: design of multifunction Nanoscale materials.
Talmon Yeshayahu	Chemical Engineering	Nano-aggregates in aqueous and non-aqueous surfactant and surfactant/polymer system; organic and inorganic Nanotube systems; biological Nano-aggregates; cryo-TEM and high-resolution cryo-SEM
Tsur Yoed	Chemical Engineering	Electroceramics, synthesis stabilization and characterization of Nanopowders.
Varenberg Michael	Mechanical Engineering	Tribology.
Weihs Daniel	Aerospace Engineering	Biological fluid mechanics, fluid flow in small dimensions, miniature aircraft.
Yaish Yuval	Electrical Engineering	Electrical and mechanical characterization of one dimensional structures, like carbon Nanotubes and silicon Nanowires.
Yariv Ehud	Mathematics	Low Reynolds number Nano-fluid mechanics.
Zolotoyabko Emil	Materials Science and Eng.	Characterization of Nanoscale materials and materials systems by x-ray diffraction techniques and development of new characterization techniques.
Zussman Eyal	Mechanical Engineering	Unique electrospinning method for fabrication of Nanofibers enabling the formation of conducting polymers or other materials.
NANOBIOTECHNOLOGY & NANOMEDICINE		
Adam Dan	Biomedical Engineering	Enhanced electromagnetic/acoustic power deposition in biological dissipative slabs; cell therapeutic strategies by Nanoscale streaming and pressure stimulations.
Adir Noam	Chemistry	The relationship between the 3D structures of proteins and their function, X-ray crystallography, biomimetics.
Admon Arie	Biology	Cancer immunology and proteomics.
Alian Akram	Biology	Stuctural biology: we use X-ray crystallography to decipher, at the atomic level, the molecular mechanisms of protein-protein and protein-nucleic acid interactions, drug mode of action, and drug resistance.
Ankri Serge	Medicine	Epigenetic regulation of gene expression, virulence, parasitology, DNA methylation, metabolism.
Amit Roee	Biotechnology & Food Eng.	Research combines synthetic biology with advanced imaging techniques to study problems associated with information transfer at the molecular level in biology.
Arad Zeev	Biology	Comparative physiology and eco-physiology from cellular to whole organism.
Arava Yoav	Biology	Nanoscale biological complexes, Biological interactions in the Nano scale.
Armon Robert	Civil & Environ. Engineering	Sol-gel imprinting with microorganisms for detection of pathogens.
Aronheim Ami	Medicine	Protein-protein interaction in the c-jun N-terminal kinase signaling pathway and eluciadation of cardiac hypertrophy pathways.
Ayoub Nabieh	Biology	Undertake a genome-wide survey of target genes which are transcriptonally regulated by the demethylase activity of KDM4A-D proteins, using cutting-edge ChIP-sequencing technology.
Ben Yosef Tamar	Medicine	Genetics of vision loss.
Beja Oded	Biology	Metagenomics, environmental genomics, microbial ecology.
Bercovici Moran	Mechanical Engineering	Lab-on-a-chip devices for rapid molecular diagnostics.
Beyar Rafael	Medicine	Application of Nanotechnology to cardiac stents.
Bianco-Peled Havazelet	Chemical Engineering	Nanostructured polymers for biomedical applications.
Binah Ofer	Medicine	Electrophysiological and structural myocardial remodeling using micro electrode array, confocal microscopy and molecular biology.
Brandon Simon	Chemical Engineering	Brownian dynamics and Monte Carlo simulations of protein crystals.
Choder Mordechai	Medicine	Relation between structure and function of Nanoscale biological complexes.
Danino Dganit	Biotechnology & Food Eng.	Cryo-TEM; Self-assembly and Nanostructure of soft-matter.
Derdikman Dori	Medicine	Recording of nerve cells in the brain during tasks of learning and memory.

*Researchers may appear in more than one category

FACULTY DIRECTORY

FACULTY MEMBER	FACULTY	RESEARCH
Dinnar Uri	Biomedical Engineering	Biological flows in microchannels.
Etsion Izhak	Mechanical Engineering	Friction wear and lubrication on the Nanoscale.
Falik Zaccai Tzipora	Medicine	Clinical characterization and identification of genes responsible for rare genetic diseases.
Fishman Ayelet	Biotechnology and Food Eng.	Enzyme immobilization on solid supports In situ product removal using micro and Nanoparticles.
Geiger Dan	Computer Science	Using Nanotechnology for gene mapping.
Gepstein Lior	Medicine	Modification of electrical activity of the heart using cellular implants.
Gershoni-Baruch Ruth	Medicine	Delineating new and old genetic diseases as regards clinical and molecular aspects.
Glickman Michael	Biology	Use of energy from ATP hydrolysis for protein conformational changes.
Green Michal	Civil and Environmental Eng	Immobilization of bacteria in fabricated Nanofibers.
Harel Amnon	Biology	Reconstituting nuclear assembly on a silicon chip.
Hen Arnon	Biology	Nanomolecular machines. Biological molecular motors. Design and engineering.
Hershberg Ruth	Medicine	Genome evolution at a single cell level.
Horowitz Benjamin A	Biology	Reconstituting nuclear assembly on a silicon chip.
Horowitz Moshe	Electrical Engineering	Nanooptical structures, Inverse Scattering Theory, Periodic optical Nanostructures, Ultrashort pulses.
Itskovitz-Eldor Joseph	Medicine	Embryonic Stem Cells and Nanofiber scaffolds for tissue engineering.
Kahn Itamar	Medicine	Identify biomarkers of progressive neurodegenerative conditions and basic organizing principles of large-scale neural systems. Using multi-scale imaging of neural systems.
Kaplan Ariel	Biology	Single-molecule biophysics, Force spectroscopy, Molecular motors.
Kashi Yechezkel	Biotechnology & Food Eng.	Optic fiber microarray for rapid bacterial identification and typing.
Keinan Ehud	Chemistry	Biomolecular computing devices based on DNA and on synthetic compounds; molecular rotary motors.
Keren Kinneret	Physics	Biophysical aspects of cell motility. Self-organization in biological systems. Interface between molecular biology and Nanotechnology
Kimmel Eitan	Biomedical Engineering	Motion of Nanoparticles and intracellular organelles to investigate local viscoelastic properties of cells and mechanotransduction underload.
Kurant Estee	Medicine	Cell biology, Developmental biology, Genetics.
Landesberg Amir	Biomedical Engineering	Biophysics of the muscle molecular motor, biological control of sub-cellular Nanosystems for therapeutic modalities.
Lanir Yoram	Biomedical Engineering	Forced and spontaneous Nanomotion of the cytoskeleton as a probe for intracellular rheology and remodeling.
Lesmes Uri	Biotechnology & Food Eng.	Food Nanotechnology: Controlling lipid oxidation and food delivery systems by novel strategies of rationally designed food colloids and interfaces. Development of structured emulsions and other advanced formulations for food and biotechnological applications.
Levenberg Shulamit	Biomedical Engineering	Nano- and micro-manipulations of embryonic stem cell differentiation and 3D organization, Nanodesign of biopolymers for tissue engineering.
Levi Ben-zion	Biotechnology and Food Eng.	Host-Pathogen Interaction: Enhancement of the killing activity of Macrophage phagolysosome with rational designed Nanoparticles.
Lifschitz Eliezer	Biology	Regulation of floral transition and leaf morphogenesis by interacting systemic gradients of florigen and auxin.
Lindell Debbie	Biology	Cyanobacterial host-virus interactions.
Livne Erella	Medicine	Scaffolding for tissue engineering and regeneration, Bone Research Group for Biotechnology by Nanotechnology.
Livney Yoav	Biotechnology & Food Eng.	Nanocapsular vehicles for programmed release of bioactive compounds using self-assembling biopolymers.
Lotan Noah	Biomedical Engineering	Biomedical/biotechnological use of submicron size particulate materials.
Machluf Marcelle	Biotechnology and Food Eng.	Developing Nano-particles for the delivery of anti cancer drugs to the brain and other organ.
Mandel-Gutfreund Yael	Biology	Computational Molecular Biology.
Melamed Phillipa	Biology	Researching protein-DNA interactions in regulating gene expression of hormones.
Meller Amit	Biomedical Engineering	Elucidating the physics of biomolecules in confined spaces and under strong electromagnetic fields.
Meyron-Holtz Esther	Biotechology and Food Eng.	Ferritin-protein as a Nanocapsule for intercellular iron transport.
Moiseyev Nimrod	Chemistry	Plasmonics for Nanophotonics.
Mor Amram	Biotechnology & Food Eng.	Design, synthesis and characterization of antimicrobial peptide-like copolymers.

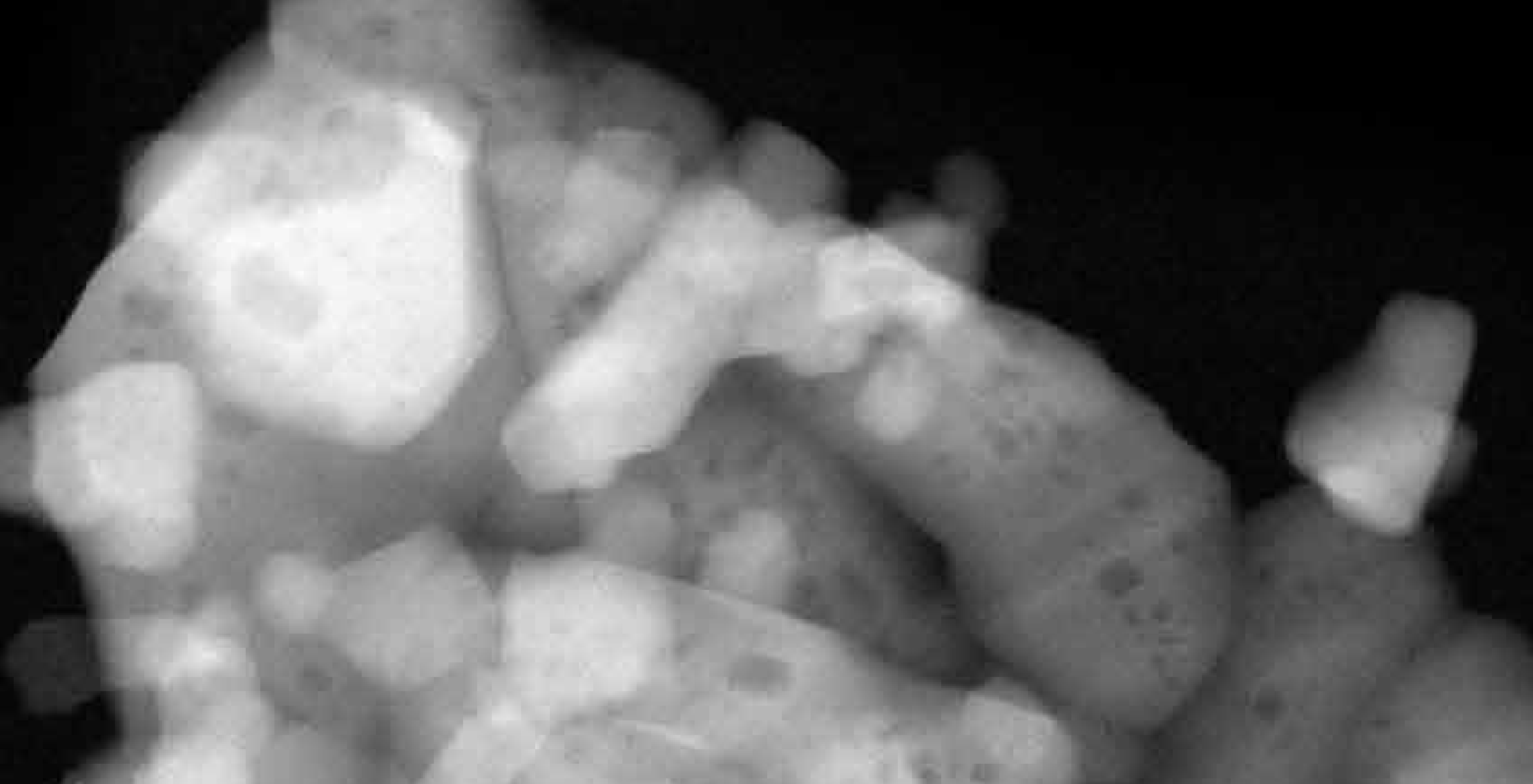
FACULTY DIRECTORY

FACULTY MEMBER	FACULTY	RESEARCH
Nemirovsky Yael	Electrical Engineering	MEMS - modeling and simulations; MEMS technology - in particular combining CMOS-SOI-MEMS, System on Chip (SOC), vertical integration and packaging. MEMS Applications: Electro-optical and Optical MEMS, IR sensors, Intertial Sensors, Cantilevers based sensors and biosensors, RF MEMS, BioMEMS, MicroFluidics, Lab-on-a-chip, Microvalves, Micropumps, Actuators (electrostatic, magnetic), Novel applications of MEMS.
Podbilewicz Benjamin	Biology	Determination of the 3D structure of the first developmental cell fusion protein.
Reiter Yoram	Biology	Selection of antibodies and peptides against electronic materials, electrical control over bioreactions.
Savaldi-Goldstein Sigal	Biology	Small-molecule hormone signaling.
Schuster Gadi	Biology	Junctions and networks of oligonucleotide-conjugated polymer and polypeptide-conjugate polymer hybrids, applicable in Nanoelectronics.
Segal Ester	Biotechnology and Food Eng.	Multifunctional Nanomaterials for advanced applications, Sensors and Biosensors.
Seliktar Dror	Biomedical Engineering	Biomaterials for tissue engineering; synthetic modification of biological proteins for cellular therapeutics; polymers for cell surface manipulation and extracellular interactions.
Shaked Yuval	Medicine	Small molecule drugs based on Nano-technology platform.
Shavit Uri	Civil & Environmental Eng.	Pure scale modeling and bio physical interaction in the ocean and soils.
Shen-Orr Shai	Medicine	System Immunology, Network biology, Human Immune Monitoring Development.
Shimoni Eyal	Bio & Food Engineering	Effects of Nano-environment on protein interactions with surfaces, Nanoencapsulation, biochips, biopolymer food grade films.
Shoham Shy	Biomedical Engineering	Patterned neurotransmitter uncaging for spatiotemporal control of neural structures, two-photon microscopy in live tissues.
Shoham Yuval	Biotechnology & Food Eng.	Rational design and construction of programmable enzymatic Nanoreactors.
Shoshany Maxim	Civil & Environmental Eng.	Self organization of protein patterns of different spatial and temporal scales.
Sivan Uri	Physics	Selection of antibodies and peptides against electronic materials, electrical control over bioreactions, bioassembly of electronic devices.
Skorecki Karl	Medicine	Cellular Machinery and Molecular Transporters.
Stanhill Ariel	Medicine	Revealing the dynamics of substrate processing by the 26S proteasome.
Sznitman Josue	Biomedical Engineering	Mechanisms governing the transport and deposition of inhaled Nano-particles in lung airways and the network of blood capillaries within lung tissue.
Talmon Yeshayahu	Chemical Engineering	Nano-aggregates in aqueous and non-aqueous surfactant and surfactant/polymer system; organic and inorganic Nanotube systems; biological Nano-aggregates; cryo-TEM and high-resolution cryo-SEM
Tzlil Shelly	Mechanical Engineering	Cell mechanics and cell mechanosensing, Nerve regeneration using mechanical signals.
Weihs Daphne	Biomedical Engineering	Nanostructure, mechanics, and microrheology of internal regions of live cells, with application to the characterization, diagnostics, and treatment of disease.
Yanai Itai	Biology	Cellular Machinery and Molecular Transporters.
Yelin Dvir	Biomedical Engineering	Nanoparticled and ultrashort pulses for biomedical applications.
Zinder Oren	Medicine	Miniaturization of clinical laboratory instrumentation and utilization of minute biological sample volumes.
Ziv Noam	Medicine	Formation, maintenance, turnover and elimination of synaptic connections.
NANOMECHANICS		
Adler Joan	Physics	Atomistic Simulations of Nanodiamond and Nanotubes.
Bar-Yoseph Pinhas	Mechanical Engineering	Computational Nanomechanics.
Buks Eyal	Electrical Engineering	NEMS and Nanoelectronics.
Eisenberger Moshe	Civil and Environmental Eng.	Mechanical behavior of Nanotubes.
Elata David	Mechanical Engineering	MEMS, tensile test systems.
Etsion Izhak	Mechanical Engineering	Friction wear and lubrication on the Nanoscale.
Gendelman Oleg	Mechanical Engineering	Heat transport in Nanosystems; Nanomechanics of polymer systems; mechanical and thermal properties of Nanostructured metals.
Givli Sefi	Mechanical Engineering	Theoretical modeling of the mechanical behavior of heterogeneous Nano-structures.

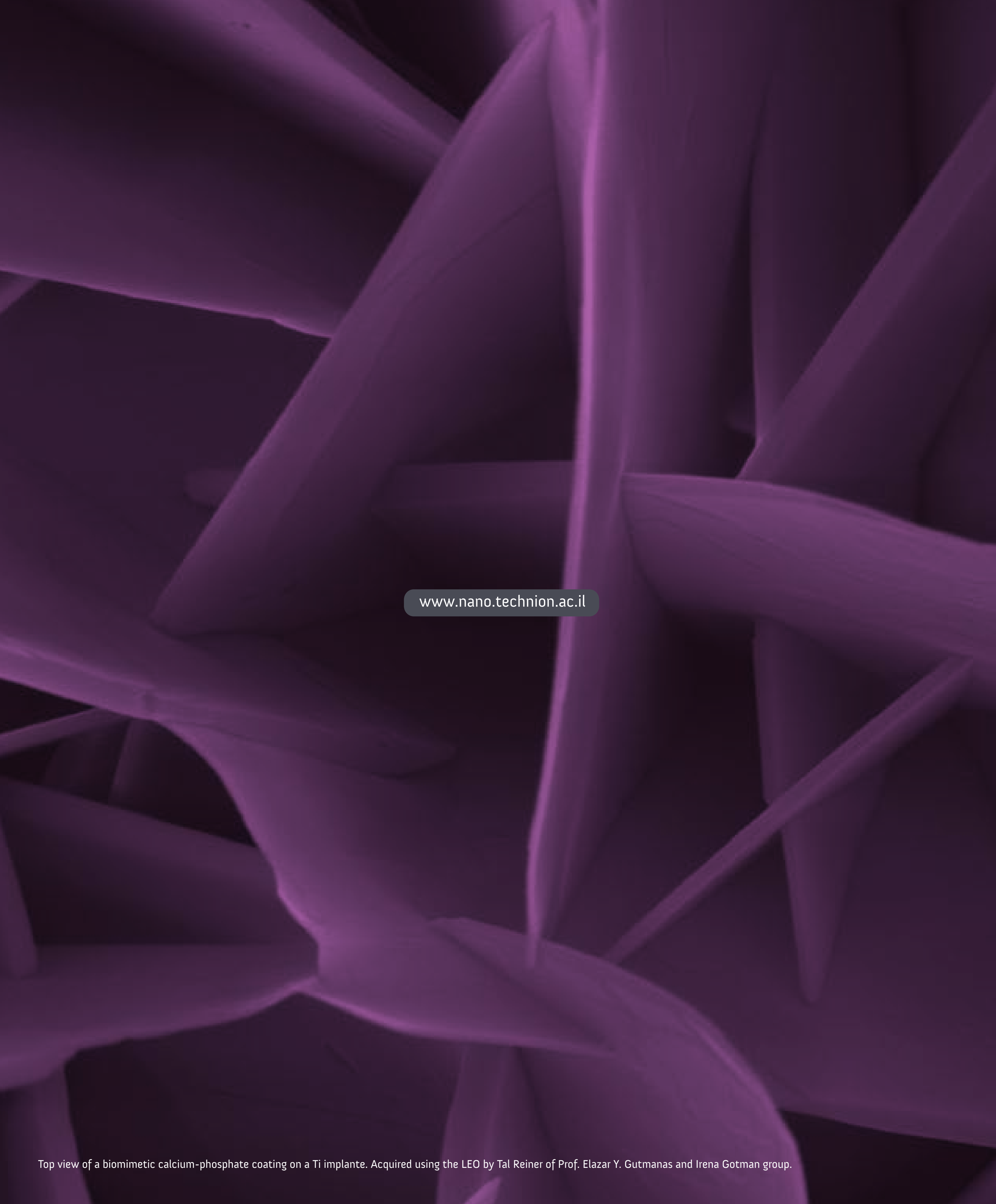
*Researchers may appear in more than one category

FACULTY DIRECTORY

FACULTY MEMBER	FACULTY	RESEARCH
Gottlieb Oded	Mechanical Engineering	Non-linear dynamics, stability, and control of SPM's and NEMS, quasi-continuum modeling, multiple-scale asymptotics and bifurcation analysis of Nanoresonators.
Kaplan Ariel	Biology	Single-molecule biophysics, Force spectroscopy, .
Mizrahi Joseph	Biomedical Engineering	Tissue engineering for articular cartilage.
Mordehai Dan	Mechanical Engineering	Structure & properties of interfaces, Contact Mechanics at the Nanoscale.
Or Yizhar	Mechanical Engineering	Nanorobotics, Dynamics of miniaturized swimmers, Biological fluid mechanics.
Rittel Danny	Mechanical Engineering	Dynamic plasticity of Nanolayers, Analytycal and experimental aspects in Nanohardness testing, Failure at the Nanoscale.
Rubinstein Koby	Mathematics	Microscopic vibrations of small piezoelectric rods; transport in quantum wire networks.
Shilo Doron	Mechanical Engineering	Tensile test systems.
Sznitman Josue	Biomedical Engineering	Mecanisms governing the transport and deposition of inhaled Nano-particles in lung airways and the network of blood capillaries within lung tissue.
Varenberg Michael	Mechanical Engineering	Tribology.
Weihs Daniel	Aerospace Engineering	Biological fluid mechanics, fluid flow in small dimensions, miniature aircraft.
Weihs Daphne	Biomedical Engineering	Nanostructure, mechanics, and microrheology of internal regions of live cells, with application to the characterization, diagnostics, and treatment of disease.
Yariv Ehud	Mathematics	Low Reynolds number Nano-fluid mechanics.
Yossifon Gilad	Mechanical Engineering	Nanofluidic based Lab-on-a-chip devices.
Zussman Eyal	Mechanical Engineering	Unique electrospinning method for fabrication of Nanofibers enabling the formation of conducting polymers or other materials.



> “Nanotechnology is probably, as a phenomenon, the single most important new emerging force in technology.”
>
> - Charlie Harris, CEO, Harris & Harris Group



Top view of a biomimetic calcium-phosphate coating on a Ti implante. Acquired using the LEO by Tal Reiner of Prof. Elazar Y. Gutmanas and Irena Gotman group.