2017

ANNUAL REPORT

Y. Golan,
Institute Director

IKI Ilse Katz Institute for Nanoscale Science and Technology

אוניברסיטת בן-גוריון בנגב
Ben-Gurion University of the Negev

The purpose of this ANNUAL REVIEW to present a representative selection of our activities and accomplishments - based on a lay orientation - to give our supporters a general representation of our undertakings. Further details, explanations, specifics, and clarifications will gladly be provided upon request.

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ACKNOWLEDGMENTS

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From the Director

Dear Friends and Supporters of the Ilse Katz Institute for Nanoscale Science and Technology (IKI),

I am happy to present you with our annual report, which includes selected highlights from the nanotechnology activities here at BGU during the course of 2017.

On behalf of the faculty, staff, and students of the IKI, I wish to thank you for your inspiration, encouragement, and support. Your partnership underpins all that we have accomplished as outlined in the following pages. My hope for 2018 is that our partners and friends worldwide sustain their generous support to enable the continuation of our exciting journey here at IKI.

And of course, I repeat my own personal message, which is that I hope to go beyond the printed page and host you in person at the IKI to show you the “very big world of very small dimensions.”

Please come visit...
you’ll be amazed.

Sincerely yours,

Y. Golan.

Yuval Golan, PhD
Professor of Materials Engineering
Director of the Ilse Katz Institute for Nanoscale Science and Technology

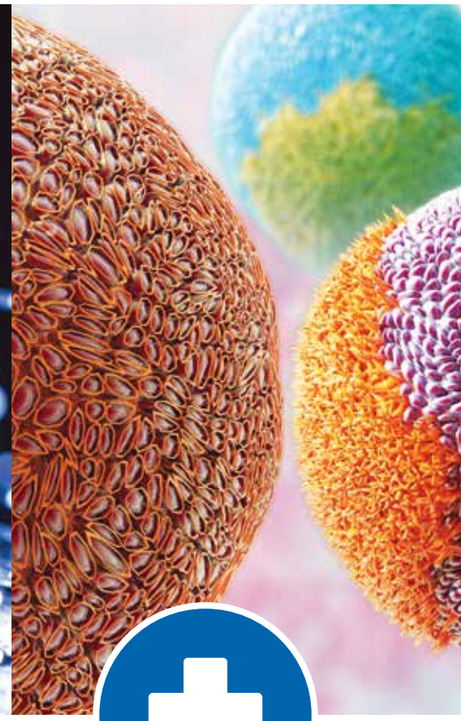
Our Vision

Our vision for the IKI at BGU is to cement its status as a recognized center of world class scientific research and education based on the continuing development of nanotechnologies and their resultant application to central challenges to benefit the Negev, the State of Israel, and society at-large.

The vision of the IKI is based on three key focal areas of interest

Nanotechnology and
Energy

Nanotechnology and
Photonics



Nanotechnology and
Human Health

Our Mission

The mission of the IKI is to promote, enable, and support innovative nanoscale research and education at BGU that will meet the challenges in our focal areas of interest.

To fulfill this mission, the IKI recruits and supports leading researchers; attracts excellent students to this field; establishes and operates enabling infrastructure to facilitate cutting-edge research; promotes industry-academia interactions to focus and implement the research; pursues development activities (seminars, workshops, etc.); and lastly, engages in fundraising to ensure that it has the budgetary resources necessary for the fulfillment of its mission.

Key Actions in Support of our Stated Mission

The IKI engages in a variety of 'key actions' in support of the Institute's stated mission. These include the items briefly noted below (which are discussed in greater detail later in the report).

Recruitment

The Institute recruited three new members to its ranks, two of who are new appointees to BGU who have shown outstanding potential in their abilities to contribute to the totality of IKI research and scientific pursuit. This year, too, the Ilse Katz Institute adhered to its commitment to hire only "the best and brightest".

New University Appointee:
Dr. Eran Edri,
Dept. of Chemical Engineering

Dr. Edri's overarching goal is the design and fabrication of specialized devices that will convert and store solar energy using advanced materials and methodologies, ultimately leading to energy production which can meet overall societal needs.

New University Appointee:
Dr. Vered Tzin,
The Jacob Blaustein Institutes for Desert Research

Dr. Tzin seeks to investigate the metabolic processes involved in plant defense mechanisms. Her long-term goal is to specifically identify the genes and molecular markers that can be targeted in the control of agricultural pests to generate robust, resistant plants. In this way, Dr. Tzin can help improve crop yield and food security.

New IKI Recruit:
Prof. Amiel A. Ishaaya,
Dept. of Electrical and Computer Engineering

Prof. Ishaaya is an active researcher in the area of nano-photonics. His research is focused on photonic devices, nano-fabrication using pulsed lasers, silicon-based nanostructures and the fabrication of multicore fibers.

State-of-the-art Equipment and Instrumentation for Advanced Science and Technology

Excellence in science and technology demands cutting edge equipment and instrumentation. The acquisition of new and updated advanced scientific equipment and instrumentation is a matter of capacity building and strategic investment for the IKI.

The combination of the “best and the brightest” researchers working with the most advanced scientific equipment is the key to achieving new heights (and new sub-nanometer resolutions) for the Ilse Katz Institute.

Listed below are several representative examples of equipment acquisitions in 2017.

All equipment items were carefully chosen to best leverage IKI capabilities in the focal areas of Nanotechnology and Energy; Nanotechnology and Photonics; and Nanotechnology and Human Health.

The FEI Verios 460L Field-Emission Scanning Electron Microscope (FESEM) working in our lab

The FEI Verios 460L Field-Emission Scanning Electron Microscope (FESEM)

The FEI Verios 460L is a high-resolution Schottkey emitter SEM. Through clever design, the Verios 460L allows for ultra-high resolution imaging at low energy on insulating samples with no conductive coating.

The Verios 460L has an integrated sample bias system that simultaneously allows for high energy in the electron optical column and low electron energy in the sample. This setup facilitates the best of both worlds: high-energy electrons allow for more precise control, while low-energy electrons show greater surface detail, create less beam damage, and reduce charging effects. High-resolution, high-contrast images are obtained without the need to transition to transmission electron microscopy (TEM), or other imaging techniques.

Scanning electron microscopy (SEM) is a critical enabling tool for research in nanotechnology, and we expect that the FEI Verios 460L FESEM will "make all the difference" in our research endeavors.

IKI research scientists will take advantage of the high-resolution scanning electron microscope for cutting-edge research in the specialized fields noted below:

- **Medicine** - Nano-carriers for targeted drug delivery
- **Homeland Security** - New thin film materials for night-vision applications
- **Energy** - Development of new photovoltaic nanomaterials
- **Water** - High-performance membranes for water treatment, desalination, and purification

Reactive Ion Etching (Plasma-Therm ECR/SLR 740)

Reactive Ion Etching (RIE) is the simplest configuration of dry etching equipment. RIE refers to a parallel plate hardware arrangement where the substrate is placed on a biased electrode (the cathode) facing a grounded electrode. RIE processes are known for higher pressure operating regimes.

RIE processes can also be used for surface preparation prior to deposition or other process steps.

This specific model is a dual chamber reactive ion etching (RIE) instrument, designed to etch substances such as, silicon, polysilicon, quartz, silicon nitride (Si3N4) and organic solids.

BGU was chosen as the recipient of this piece of equipment as the IKI makes every effort to ensure research proceeds from the laboratory to the fabrication facility: the "lab to fab" approach.

This piece of equipment was a donation from Intel directly to the IKI's Nanofabrication Center.

HORIBA LabRAM HR system for RAMAN spectroscopy

The state of the art LabRAM HR Evolution system includes improvements in mapping (imaging) capabilities and low frequencies measurements.

Raman spectroscopy provides key information about chemical composition and material structure and can be used in diverse applications (2D materials, life sciences, pharmaceuticals, materials, semiconductors, geology, art and archeology)

Meeting the needs of IKI researchers in 2019-2021 Plans for future acquisitions

Focused Ion Beam Tool (Dual Beam FIB)

The Dual Beam FIB system employs a focused ion beam for site-specific material removal, after which an electron beam provides non-destructive imaging of the exposed sub-surface features.

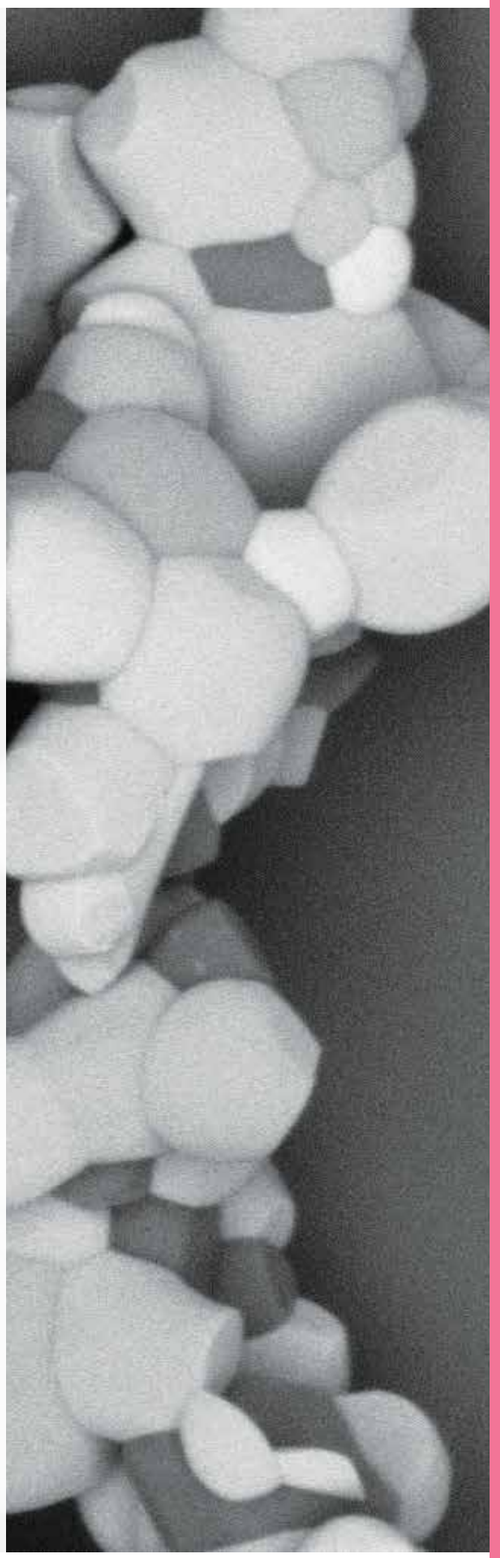
Examples of applications:

- **Material Science, Electro-optics** (Preparation of TEM lamella, characterization of thin film coatings)
- **Life science and medicine** (Cross-sectioning and tomography; Serial sectioning of tissue for structural studies)

Photovoltaic and Solar Cell Characterization

Laboratory capabilities will include:

- UV-Vis-NIR Spectrophotometer to measure optical properties
- Quantum Efficiency (QE) measurements to assess efficiency of device conversion of incident light to electrical energy at a given wavelength
- Solar cell simulator



Research and Licensing Collaborations of the IKI Members for 2017

Prof. Moti Herskowitz
In 2017, two high level and challenging collaborative agreements led by Prof. Herskowitz were signed by BGN.

1. A Research and Licensing Agreement with a leading crop protection company dedicated to providing the crop protection industry with innovative solutions that simplify and enable growth in farming.

2. A Research and Licensing Agreement with an Israeli company in the field of alternative fuels was signed for the implementation of certain BGN inventions of Prof. Herskowitz for the conversion of mixtures of fatty acids and oil to liquid fuels.

Prof. Yosi Kost
Two research collaborations were signed using Prof. Kost's deep scientific knowledge and world renown expertise in the fields of drug delivery and ultrasound.

1. An agreement was signed with Ferring Pharmaceuticals through its Israel subsidiary Ferring Holding Ltd. for the development by Prof. Kost of an implantable, controlled delivery device.

2. A second research collaboration was signed with Insightec, an Israeli medical device company, for the development of ultrasound agents for clinical applications.

Prof. Yosi Kost and Prof. Smadar Cohen
Two option agreements were signed with an Israeli company in the field of muscular diseases for the development of dedicated systems for the delivery of nucleic acid based therapeutics specifically targeted to muscles.

Prof. Robert Marks
A next-generation quantitative point-of-care diagnostics system based on electrochemical lateral flow immunosensors jointly developed by Prof. Marks of the IKI and researchers at Nanyang Technological University (NTU) has been exclusively licensed by BGN and NTU to Biosensorix PTE, a startup company incorporated in Singapore. The quantitative point-of-care rapid diagnostics can be used at the patient's bedside, at the doctor's office or at home by the patient.

Education

The IKI's well-established educational activities continued in 2017. These included nano workshops and seminars, undergraduate and graduate academic programs in nanoscience/nanotechnology (NS/NT), and the active participation of the IKI in the incorporation of nanoscience modules in the curriculum of relevant departments on campus.

Undergraduates

In 2017, nine outstanding students graduated from the IKI's specialized undergraduate nanotechnology program, which is based on a "double major" program of study that culminates in two distinct BSc degrees: one in Chemistry and one in Chemical Engineering. In addition, 13 new undergraduate students - all with the highest credentials - entered the IKI program.

Doctoral Students

Eight years ago, the IKI made a decision to adapt to the highly interdisciplinary nature of nanoscience by initiating an interdisciplinary PhD degree program to encourage student mobility across traditional academic dividing lines. In 2017, two students graduated from this program:

- **Dr. Alon Szczupak** was recruited by Fluence as an EBR Researcher, Products and Innovation and is responsible for the development of innovative processes for wastewater treatment and for the design and implementation of experiments for their early-stage characterization.

- **Dr. Michael Volokh** chose to remain in academia and became a staff research engineer in BGU's Department of Chemistry at Ben-Gurion University of the Negev.

Five additional PhD students are expected to graduate from the program in 2018.

Specialized Training and Customized Exposure for Students

- Based on the IKI's focal area of Nanotechnology and Human Health (Nano-Med), it offers a special graduate course for advanced biological and biomedical characterization techniques that covers both theoretical background and "hands-on" laboratory training.

- Fourth year undergraduate students in materials engineering carried out a research project on nano-ceramics using advanced scientific techniques, including electron microscopy, x-ray scattering, and x-ray spectroscopy.

- The IKI reached out across campus and across disciplines and established a strong collaboration between materials science and archaeology research.

- The IKI has continued to practice an "open doors" policy, encouraging tours and training sessions in nanoscale materials characterization, with a special emphasis on analytical techniques.

Noteworthy Achievements

Electrified Graphene: “Bad News” for Bacteria

Scientists at Ben-Gurion University of the Negev, Israel, and Rice University, Houston, USA, have discovered that laser-induced graphene (LIG) is a highly effective anti-fouling material that, when electrified, becomes a “bacteria zapper.”

LIG is a spongy version of graphene – the single-atom layer of carbon atoms – developed three years ago by Rice University chemist Dr. James Tour. LIG is formed by burning partway through an inexpensive polyimide sheet with a laser, which turns the surface into a lattice of interconnected graphene sheets.

When used as electrodes with a small applied voltage, LIG becomes the bacterial equivalent of a backyard bug zapper...in this case a “bacteria zapper.”

When 1.1 to 2.5 volts of electricity were applied, the highly conductive LIG electrodes (i.e. electrified graphene) exhibited greatly enhanced antibacterial properties.

Dr. Christopher Arnusch, a senior lecturer at BGU’s Zuckerberg Institute for Water Research and IKI, specializes in applying advanced materials in water purification technologies. His lab tested LIG electrodes in a bacteria-laden solution with 10 percent secondary treated wastewater. They found that after nine hours at 2.5 volts, 99.9% of the bacteria were killed. Furthermore, the electrodes strongly resisted biofouling (the buildup of microorganisms or other biological material on wet surfaces).

Moreover, they developed the LIG process on other materials such as polysulfones, which are popular water treatment membrane materials.

The researchers suspect that the bacteria meet their demise through a combination of contact with the rough surface of LIG, the electrical charge, and the toxicity resulting from localized production of hydrogen peroxide. In addition, the uniquely rough structure of the LIG surfaces plays a role in preventing the formation of bacterial biofilms.

Indeed, the researchers noted that this form of graphene is extremely resistant to biofilm formation, a valuable property that holds great promise for a vast array of settings and applications where surfaces are susceptible to biofouling, like water treatment plants, oil-drilling operations, hospital infrastructure, and seawater pipes, to name but a few of the myriad examples.

Summary of Competitive Research Grant (1)

Hierarchical Inorganic Nanomaterials as Next-Generation Catalysts and Filters

Project ID: 755301
Duration: 18 Months
Dates: 2017-03-01 to 2018-08-31
Program: ERC - 'EXCELLENT SCIENCE'
Scheme: Proof-of-Concept (PoC) Grant
Awardee: Prof. Taleb Mokari
Affiliation: Chemistry Dep. and Ilse Katz Institute for Nanoscale Science & Technology
Purpose: Advanced Research: "from the Lab to a Prototype"

Objective

Quantum confinement in semiconducting crystals, which is achieved by controlling the size and shape of nanoscale crystals, is a topic of considerable scientific interest and technological applications, such as optoelectronic devices. Heterostructures containing two or more different semiconducting nanocrystals add further control of both charge redistribution and the built-in potential. In the coming decades, two major global grand challenges will continue to attract the attention of scientists and engineers in academia and industry: the quests for clean water and clean energy. This proof of concept grant establishes the development of two prototypes – a water oxidation catalyst and a water purification filter – by creating inexpensive, abundant and versatile hierarchical structures of inorganic nanomaterials (HSINs).

The formation of HSINs has been one of the major obstacles toward achieving a technological progress in various applications. Presently, the fabrication of well-defined 3-D structures can be achieved either by photo/electro lithography, assembly, 3D printing or template-mediated methods. Various structures with high quality/yield can be obtained by using those techniques. These methods, however, are plagued by their high costs, the difficulties of fabricating free-standing structures, and limited throughput.

https://cordis.europa.eu/project/rcn/208123_en.html

Summary of Competitive Research Grant (2)

Quantum Phenomena in Hybrid Systems: Interfacing Engineered Materials and Nanostructures with Atomic Systems

Duration: 5 Years (2015- 2019)
Program: (DIP) German-Israeli Project Cooperation
Purpose: Collaborative Research: Germany & Israel
Israeli Principal Investigator (PI): Prof. Ron Folman
Affiliation: Physics Dep. and Ilse Katz Institute for Nanoscale Science & Technology
Keywords: Quantum Optics; Cold Atoms; Atom Chips; Nanostructures; Atom - Electron Coupling

Project Description (excerpt)

In the last decade, the field of quantum optics has achieved impressive control over the multi-particle quantum state of atomic systems through technologies such as cold ions, cold atoms and even room temperature nitrogen vacancy centers (NVs) that behave as atom-like systems in a diamond crystal. In parallel, solid state systems based on electrons – e.g. superconducting systems and quantum dots – have achieved such a high level of control and engineered interactions that they are rivaling atomic systems.

For fundamental science and 21st century technological applications we aim for hybridization, where atomic and solid state systems are coupled. Atomic chips are devices in which electron-based circuits on chip surfaces are coupled to isolated atomic systems positioned above. Such coupling has already given rise to valuable insight both on the atomic system and on the electron system.

We plan advancing into new regimes where atom-electron coupling is initiated in novel kinds of interfaces leading to new insight on each of the systems and finally to a coherent (quantum) coupling between them - in situations where the electron quantum degrees of freedom are also under control.

We will utilize Atom chips in three configurations defined by the choice of the sensor system: One consists of cold single ions, ion crystals or ions ejected from a trap and in free-flight, the second is an ensemble of cold atoms and the third configuration comprises ensembles of NVs. Each system has its own advantages.

http://gepris.dfg.de/gepris/projekt/264554749

Recruitment of World-Class Researchers

IKI works with BGU senior administration to ensure that new faculty are provided with all of the major infrastructure items required for their research. This is in accordance with what are among the main priorities of the IKI – minimizing the ongoing 'brain drain' of Israeli researchers attracted to prestigious positions abroad and recruiting a cadre of world-class researchers and scientific investigators.

Dr. Eran Edri

Senior Lecturer with the Dept. of Chemical Engineering and the IKI

Background

Dr. Eran Edri began his academic career at BGU, where he received his bachelor's and master's degrees. He has now come "full circle" with an academic appointment as Senior Lecturer with the Dept. of Chemical Engineering (as of Oct. 2017).

Dr. Edri was recruited to BGU from the Lawrence Berkeley National Laboratory in California, where he was a postdoctoral research fellow. At the Berkeley Lab, Dr. Edri focused on artificial photosynthesis, photocatalysis, and electronic transport through molecules.

At BGU, his lab and research are dedicated to "solar energy materials and devices."

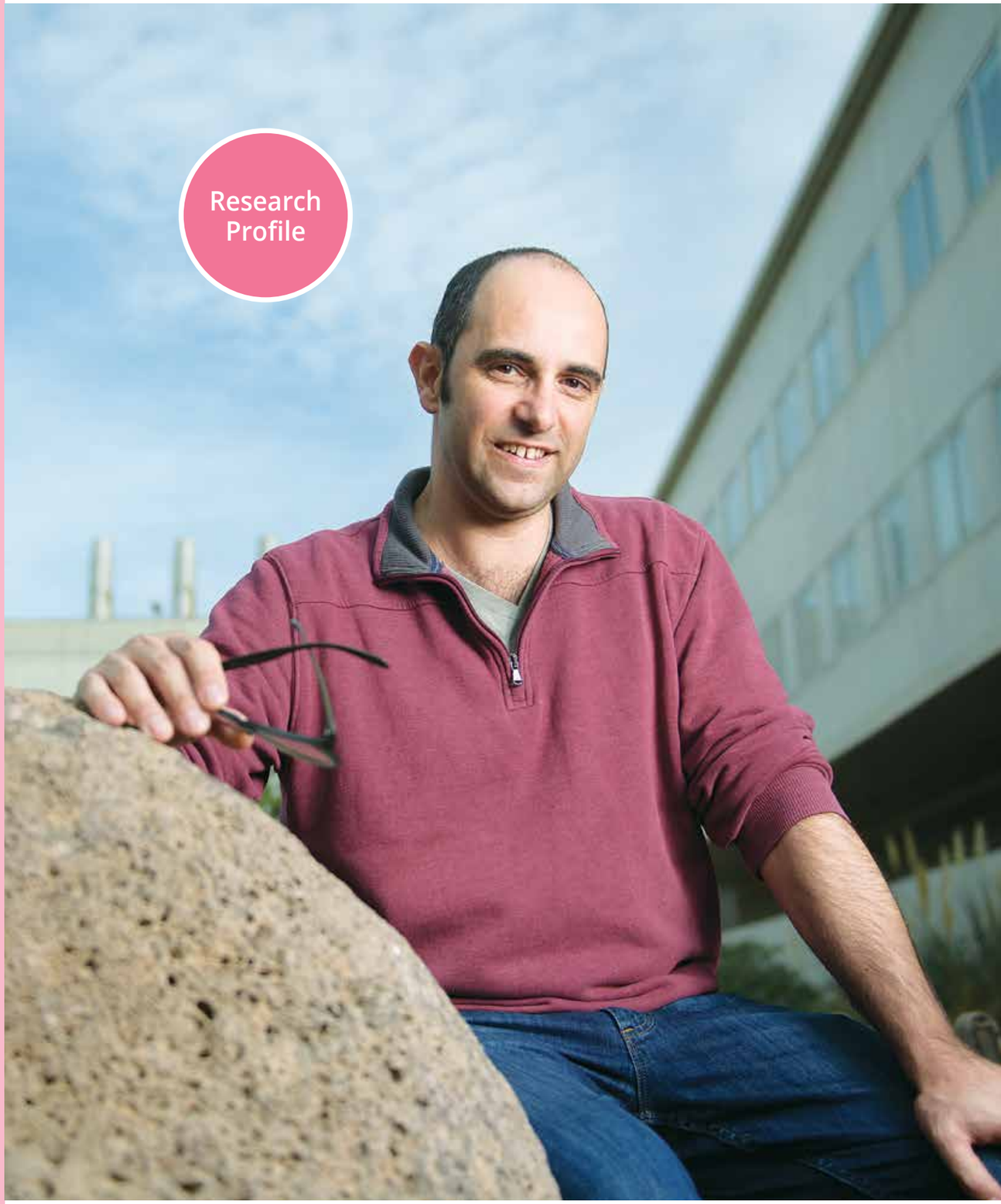
Keywords: Renewable Energies; Photochemistry; Electrochemistry; Solar Cells; Solar Fuels; Artificial Photosynthesis; Electrocatalytic processes; and Bio-hybrids (inorganic and organic materials).

Research Approach

Dr. Edri's overarching goal is the design and fabrication of specialized devices that will convert and store solar energy using advanced materials and methodologies, ultimately leading to energy production that can meet overall societal needs. Dr. Edri's multifaceted research incorporates hybrid materials, photo-electro-catalytic processes, electrochemical methods, multi-physics simulation, and photoelectron spectroscopy.

Representative Research Project from his Postdoctoral Fellowship at the Berkeley Lab

Fabrication of Core–Shell Nanotube Array for Artificial Photosynthesis Featuring an Ultrathin Composite Separation Membrane



Research Profile

Dr. Vered Tzin
French Associates Institute for Agriculture and Biotechnology of Drylands (FAAB)
The Jacob Blaustein Institutes for Desert Research, and the IKI

Dr. Vered Tzin joined BGU after several years of agricultural research at the Boyce Thompson Institute for Plant Research, an affiliate of Cornell University, located in Ithaca, New York.

At Cornell, she worked in the lab of Prof. Georg Jander where she conducted multiple research projects aimed at elucidating the nano-reaction of plant metabolic responses to herbivore attack. She gained experience in examining the changes in plant secondary metabolism induced by biotic stress cues by using genetic and ecological tools as well as nano-biochemical and analytical chemistry approaches.

Dr. Tzin used the maize nested association mapping (NAM) population, which makes maize a very useful genetic tool for quantitative trait loci (QTL) mapping and for the identification of gene involvement in defense mechanisms.

At the IKI she characterizes the structure and function of plant small molecules (i.e. metabolites), which are low molecular weight organic compounds whose mass is in the range of 50 – 1,500 Daltons. To do so, she uses advanced nano- characterization tools such as scanning electron microscopy, X-ray photoelectron spectroscopy and Raman spectroscopy.

Specific research objectives include

- Studying the biosynthesis of defense metabolites that function as deterrents of herbivores
- Characterizing the biosynthesis of small molecules that play a role in the attraction of pollinators and predators
- Elucidating the biosynthesis of essential compounds in grains that are important for livestock and human diet
- Improving plant nutrition (amino acid content) in teff, a new agriculture crop in Israel
- Bio-devices based on nano-materials for fast detection.

Overall, the Tzin Group studies crop plants, including wheat, maize Setaria, and tomato, as well as wild desert plants. The elucidation of plant metabolic processes involved in communication with pollinators and herbivores is critical for improving plant resistance. Volatile organic compounds (VOCs) and their interactions with nanomaterials are also studied in Tzin's lab.

High Impact Publications

(Representative sample)

Algov I., Grushka J., **Zarivach R., Alfonta L.**, *"Highly Efficient Flavin-Adenine Dinucleotide Glucose Dehydrogenase Fused to a Minimal Cytochrome C Domain"* **Journal of the American Chemical Society**, 6-Dec. 2017; Vol. 139, Issue 48, Pgs. 17217-17220. [Impact Factor: 13.858].

Li Y., Luong DX., Zhang J., Tarkunde YR., Kittrell C., Sargunaraj F., Ji Y., Tour JM. and **Arnusch CJ.**, *"Laser-Induced Graphene in Controlled Atmospheres: From Superhydrophilic to Superhydrophobic Surfaces"* **Advanced Materials**, 12-May 2017; Vol. 29, Issue 27, Pg. 1700496. [Impact Factor: 19.791].

Singh SP., Li Y., Zhang J., Tour JM., **Arnusch CJ.**, *"Sulfur-Doped Laser-Induced Porous Graphene Derived from Polysulfone-Class Polymers and Membranes"* **ACS Nano**, 28-Jan. 2018; Vol. 12, Issue 1, Pgs. 289-297. [Impact Factor: 13.942].

Nanda J., Rubinov B., Ivnitski D., Mukherjee R., Shtelman E., Motro Y., **Miller Y.**, Wagner N., Cohen-Luria R., **Ashkenasy G.**, *"Emergence of Native Peptide Sequences in Prebiotic Replication Networks"* **Nature Communications**, 05-Sept. 2017; Vol. 8, Issue 1, Pg. 434. [Impact Factor: 12.124].

Ashkenasy G., Hermans TM., Otto S. and Taylor AF., *"Systems Chemistry"* **Chemical Society Reviews**, 15-Feb 2017; Vol. 46, Pgs. 2543-2554. [Impact Factor: 38.618]

Silberbush O., Amit M., Roy S. and **Ashkenasy N.**, *"Significant Enhancement of Proton Transport in Bioinspired Peptide Fibrils by Single Acidic or Basic Amino Acid Mutation"* **Advanced Functional Materials**, 13-Jan. 2017; Vol. 27, Pgs. 1604624. [Impact Factor: 12.124]

Siton-Mendelson O. and **Bernheim-Groswasser A.**, *"Functional Actin Networks Under Construction: The Cooperative Action of Actin Nucleation and Elongation Factors"* **Trends in Biochemical Sciences**, 31-March 2017; Vol. 42 Issue 6, Pgs. 414-430. [Impact Factor: 16.63]

David A., *"Peptide Ligand-Modified Nanomedicines for Targeting Cells at the Tumor Microenvironment"* **Advanced Drug Delivery Reviews**, 15-Sept. 2017; Vol. 119, Pgs. 120-142. [Impact Factor: 11.764].

Zhou J., Wang K., Xu B., **Dubi Y.**, *"Photoconductance from Exciton Binding in Molecular Junctions"* **Journal of the American Chemical Society**, 10-Jan. 2018; Vol. 140, Issue 1, Pgs. 70-73. [Impact Factor: 13.858].

Nakibli Y., Mazal Y., **Dubi Y.**, Wächtler M., Amirav L., *"Size Matters: Cocatalyst Size Effect on Charge Transfer and Photocatalytic Activity"* **Nano Letters**, 10-Jan 2018; Vol. 18, Issue 1, Pgs. 357-364. [Impact Factor: 12.712].
Vardi N., Anouchi E., Yamin T., Middey S., Kareev M., Chakhalian J., **Dubi Y.**, Sharoni A., *"Ramp-reversal Memory and Phase-Boundary Scarring in Transition Metal Oxides"* **Advanced Materials**, 23-March 2017; Vol. 29, Issue 21, Pgs. 1605029. [Impact Factor: 19.791]

Cerisola F., Margalit Y., Machluf S., Roncaglia AJ., Paz JP., **Folman R.**, *"Using a Quantum Work Meter to Test Non-Equilibrium Fluctuation Theorems"* **Nature Communications**, 01-Nov. 2017; Vol. 8, Issue 1, Pg. 1241. [Impact Factor: 12.124].

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 Letters**, 10-May 2017; Vol 17, Issue 5, Pages 2778-2787. [Impact Factor: 12.712].

Akbulatov AF., Frolova L A., Griffin MP., **Katz EA.**, et al., *"Effect of Electron-Transport Material on Light-Induced Degradation of Inverted Planar Junction Perovskite Solar Cells"* **Advanced Energy Materials**, 11-Oct. 2017; Vol. 7, Issue 19. [Impact Factor: 16.721].

Oyler-Yaniv J., Oyler-Yaniv A., Shakiba M., Min NK., Chen YK., Cheng SY., **Krichevsky O.**, Altan-Bonnet N., Altan-Bonnet G., *"Catch and Release of Cytokines Mediated by Tumor Phosphatidylserine Converts t Transient Exposure into Long-Lived Inflammation"* **Molecular Cell**, 1-June 2017; Vol. 66, Issue 5, Pgs. 635-647. [Impact Factor: 14.714]

Oyler-Yaniv A., Oyler-Yaniv J., Whitlock BM., Liu Z., Germain RN., Huse M., Altan-Bonnet G., **Krichevsky O.**, *"A Tunable Diffusion-Consumption Mechanism of Cytokine Propagation Enables Plasticity in Cell-to-Cell Communication in the Immune System."* **Immunity**, 18-Apr. 2017; Vol. 46, Issue 4, Pgs. 609-620. [Impact Factor: 22.845].

Tomov TE., Tsukanov R., Glick Y., Berger Y., Liber M., Avrahami D., Gerber D., **Nir E.**, *"DNA Bipedal Motor Achieves a Large Number of Steps Due to Operation Using Microfluidics-Based Interface"* **ACS Nano**, 25-Apr. 2017; Vol. 11, Issue 4, Pgs. 4002-4008. [Impact Factor: 13.942].

Mondal S., Varenik M., Bloch DN., Atsmon-Raz Y., Jacoby G., Adler-Abramovich L., Shimon LJ., Beck R., **Miller Y.**, **Regev O.**, Gazit E., *"A Minimal Length Rigid Helical Peptide Motif Allows Rational Design of Modular Surfactants"* **Nature Communications**, 13-Jan. 2017; Vol 8, Article 14018. [Impact Factor: 12.124].

High Impact Publications

(Representative sample)

Buzaglo M., Bar IP., Varenik M., Shunak L., Pevzner S., **Regev O.**, *"Graphite-to-Graphene: Total Conversion"* **Advanced Materials**, 24-Feb. 2017;Vol. 29, Issue 8, Pgs. 1603528. [Impact Factor: 19.791].

Peng G., Xing L., Barrio J., Volokh M. and **Shalom M.**, *"A General Synthesis of Porous Carbon Nitride Films with Tunable Surface Area and Photophysical Properties"* **Angewandte Chemie-International Edition**, 26-Jan. 2018, Vol. 57, Issue 5, Pgs. 1186-1192. [Impact Factor: 11.994]

Xu J., Wang H., Zhang C., Yang X., Cao S., Yu J. and **Shalom M.**, *"From Millimeter to Subnanometer: Vapor-Solid Deposition of Carbon Nitride Hierarchical Nanostructures Directed by Supramolecular Assembly"* **Angewandte Chemie-International Edition**, 10-July 2017, Vol. 56, Issue 29 Pgs. 8426-8430. [Impact Factor: 11.994]

Ledendecker M., Schlott H., Antonietti M., Meyer B. and **Shalom M.**, *"Experimental and Theoretical Assessment of ni-Based Binary Compounds for the Hydrogen Evolution Reaction"* **Advanced Energy Materials**, 8-Mar. 2017, Vol. 7, Issue 5, Pgs. 1601735. [Impact Factor: 16.721].

Wang Y., Zeiri O., Raula M., Le Ouay B., Stellacci F., **Weinstock IA.**, *"Host-Guest Chemistry with Water-Soluble Gold Nanoparticle Supraspheres"* **Nature Nanotechnology**, Feb. 2017; Vol. 12, Issue 2, Pgs. 170-176. [Impact Factor: 38.986].

Weinstock IA., Schreiber RE. and Neumann R., *"Dioxygen in Polyoxometalate Mediated Reactions"* **Chemical Reviews**, 1-Dec 2017, Vol. 118, Issue 5, Pgs. 2680-2717. [Impact Factor: 47.928]

Algov I., Grushka J., **Zarivach R.**, **Alfonta L.**, *"Highly Efficient Flavin-Adenine Dinucleotide Glucose Dehydrogenase Fused to a Minimal Cytochrome C Domain"* **Journal of The American Chemical Society**, 15-Sep. 2017, Vol. 139, Issue 48, Pgs. 17217-17220. [Impact Factor: 13.858]

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