2018 ANNUAL REVIEW & ACTIVITY REPORT

Y. Golan, Institute Director
December 2018

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

IKI Ilse Katz Institute for Nanoscale Science and Technology

Acknowledgments

The impressive progress of the IKI was only possible due to the generous support of our donors:

Ruth Flinkman-Marandy
Henry Weiss Family
Ernest Scheller, Jr. Family
Pullyben Foundation – Yoda Leon & Luna Benoziyo
The Negev Foundation (Robert Equey & Alain Kostenbaum)
Marty and Carol Weinberg
Max and Rachel Javit

Confocal image of Squamous Cell Carcinoma (SCC) cell line of call33GFP type which expressed green fluorescent protein. The F-actin is labeled in red, and the nucleus is labeled in blue. (Prof. Yosi Kost group)

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

As Director, I can say frankly that much has been accomplished, and yet much remains to be done. The world of ultra-advanced science and technology allows for no rest, no breaks, and we have no “pause button” at our disposal. There is no possibility for complacency if we are to remain at the forefront of nanotechnology.

It is for that exact reason that I look forward to the year 2019 and the challenges that this new year holds.
I look forward to the continuation of our journey based on the continuation of support from our partners and friends worldwide. Ours is a mutual enterprise and your partnership underpins all that we have accomplished as outlined in the following pages.

On behalf of the faculty, staff, and students of the IKI,
I wish to thank you for your inspiration, encouragement,
and support.

Sincerely yours,

Y. Golan.

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

A metastatic human melanoma cell line (WM3682). This cell is over-expressing a G protein coupled receptor PAR1 that was found to take part in many cancerous pathways. The receptor is labeled with red fluorescent protein (mCherry) in the extracellular region and green fluorescent protein (GFP) in the intracellular region. This method allow us to monitor the receptor activation in response to different treatments.
(Dr. Niv Papo group)

Our Vision

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

State of the art

Equipment and Instrumentation For Advanced Science and Technology:

Excellence in science and technology demands innovative 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 2018.

Focused Ion Beam Tool (Dual Beam FIB) - FEI Helios G4 UC FESEM with FIB

The Helios G4 UC is a fully digital, Extreme High Resolution (XHR) Field Emission Scanning Electron Microscope (FE SEM) equipped with Focused Ion Beam (FIB) technology. It allows for the fast characterization of nanometer details and analysis in 2D and 3D, best in class sample preparation and flexible nanoprototyping. In combination with the most comprehensive software and application expertise, it allows for the fastest preparation of HR-S/TEM samples for a wide range of materials.

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

Applications are in both life science and materials science, and include preparation of TEM samples, serial sectioning of tissue for structural studies and 3D tomography of nanostructures and nano-devices.

Laboratory for Characterization of Photovoltaic and Photoelectrochemical Solar Cells

The laboratory includes essential equipment items for the characterization of solar cells, including:

UV-Vis-NIR Spectrophotometer (Cary 5000 + UMA, Agilent) for measuring the optical properties of materials and thin films.

Quantum Efficiency (QE) measurements (Customized PTS-2-QE/IPCE, SCIENCETECH) for measuring how efficiently the device converts the incident light into electrical energy at a given wavelength.

Solar cell simulator (AX LightLine with LA125 Homogenizing Optics, SCIENCETECH) for providing illumination approximating natural sunlight (up to 3 suns) in a controllable indoor test facility under laboratory conditions.

Meeting the needs of ISF RESEARCHERS

plans for acquisition in 2019-2021

The Israel Science Foundation (ISF) ‘Institutional Equipment Grants’ Funding Track

Big Success – Big Fundraising Needs

The ISF provides partial funding for scientific equipment defined as institutional, which “serves, assists, or caters to the needs of a wide range of users.” This program is based on “matching,” illustrating the need and importance of our donor base. In all cases, the University must provide a minimum of 50% of the purchase cost.

The Ilse Katz Institute sponsored two winning proposals, illustrating the strength of our research program as viewed through the eyes of the Israel Science Foundation.

הקרן הלאומית למדע
المؤسَّسة الإسرائيلية للعلوم
Israel Science Foundation

Electron Beam Lithography System

Primary Researchers and Intended Use:

Dr. Mark Schvartzman - Novel fabrication of optical nanostructures on unconventional non-planar substrates

Prof. Ron Folman - Expanding the fabrication potential of the atom chip within targeted specialty fields, e.g. quantum technology, electron transport effects, and cold matter

Prof. Ibrahim Abdulhalim - The customized production of nanoplasmonic and nanophotonic structures for biosensing and spectral filtering applications

Electron Beam Lithography (EBL) is a nano-patterning method based on scanning of a thin film of sensitive material (resist) with focused electron beam to draw custom 2D and 3D shapes. The beam can be focused to produce shapes sized down to a few nanometers. This grant is specifically for a dedicated EBL system for our nanofabrication center.
Applications are vast and varied, including: optics; nanophotonics; nanobiology, photonics; MEMS/NEMS, solar cells, optical waveguides, microfluidics, etc.

Deep Reactive Ion Etching [DRIE]

Primary Researchers and Intended Use:

Dr. Gil Shalev - Exploration of new avenues for high-efficiency, thin-film photovoltaics based on top-down surface nanostructuring with arrays of sub-wavelength features

Dr. Assaf Yaakobovitz - Excels in the field of nano and micro electromechanical systems (NEMS/MEMS), and he applies this work to the design of nanoscale devices

Dr. Hadar Ben Yoav - Works at the interface of biology and microelectronics and has specialized skills in integrating functional biomaterials with nanosystems for sensing and actuation techniques

DRIE is a highly anisotropic etch process used to create deep trenches and holes in wafers/substrates, typically with high aspect ratios. Reactive etching process consists of some reactive gas plasma which etches the substrate while DC voltage bias accelerated the plasma ions in the substrate direction. The forwarded flow of the ions provides anisotropy of the process.
DRIE can be used to fabricate nano-sized vertical and non-vertical structures with high aspect ratio.
These structures are crucial for many fields, such as: NEMS/MEMS; solar cells; photonics; optical waveguides; microfluidics, nanobioelectronics; nanoneedles; and porous bio-medical implant materials

each project awarded

$245,000

seeking additional funds in order to purchase

COMMERCIALIZATION & PATENTS

Prof. Lital Alfonta

Two promising Agreements were signed in 2018 – each in a different area of application based on the development of biomarkers and biosensors with:

1. PTM- an Israeli startup company developing novel biomarkers for use in the diagnosis, prevention and treatment of human diseases.

2. The Joy Venture Fund – sponsoring novel academic research seeking to bring to market consumer solutions for neuro-wellness and wellbeing by reducing stress, increasing mental and physical wellness and improving mood and emotion regulation.

Prof. Smadar Cohen

Prof. Cohens Alginate Scaffold technology was commercialized to Orgenesis Inc., a US cell therapy company, for the production of cells and cell cultures for cell therapy and especially for their implantation with Insulin producing cells for Diabetes Type 1 patients.

www.orgenesis.com

Company Overview:

Orgenesis is a vertically-integrated biopharmaceutical company with expertise and unique experience in cell therapy development and support services.

Through its subsidiary, Orgenesis Ltd., Orgenesis is developing technology designed to successfully reprogram human liver cells into glucose-responsive, fully functional, Insulin Producing Cells (IPCs).

Orgenesis believes that converting the diabetic patient's own tissue into insulin-producing cells has the potential to overcome the significant issues of donor shortage, cost and exposure to chronic immunosuppressive therapy associated with islet cell transplantation.

Technology Transfer in the Focal Area of Nano-Med

Orgenesis Announces Collaboration with Ben-Gurion University to Develop and Comercialize a Novel Scaffold Technology for Cell Translantation
23.8.18

(GLOBE NEWSWIRE) Orgenesis Inc. (NASDAQ: ORGS), a manufacturer, service provider and developer of advanced cell therapies, along with BGN Technologies, the technology transfer company of Ben-Gurion University of the Negev (BGU), announced a collaboration to develop and commercialize a novel alginate scaffold technology for cell transplantation, with an initial focus on autoimmune diseases.

The technology was invented and developed by Prof. Smadar Cohen of the Regenerative Medicine and Stem Cell (RMSC) Research Center and Dept. of Biotechnology Engineering at BGU, along with her colleague, Prof. Alon Monsonego of the Faculty of Health Sciences at BGU.

Under the license agreement, Orgenesis will receive the exclusive, worldwide right to make, develop and commercialize products utilizing the novel scaffold technology, subject to achieving certain milestones.

Prof. Moti Herskowitz

1

The collaboration with a leading **crop protection** company, dedicated to providing the crop protection industry with innovative solutions that simplify and enable growth in farming, which has been reported in our 2017 report, continued with great success in 2018 with the research plan being extended (also into 2019) and amplified.

2

A research collaboration has been initiated with Australia's Commonwealth Scientific and Industrial Research Organization (CSIRO) for a joint development for Converting Renewables and CO_2 into liquid fuel combining proprietary technologies of each CSIRO and BGU.

Dr. Christopher Arnusch

Last year, we reported on Dr. Christopher Arnusch:

Electrified Graphene: "Bad News" for Bacteria

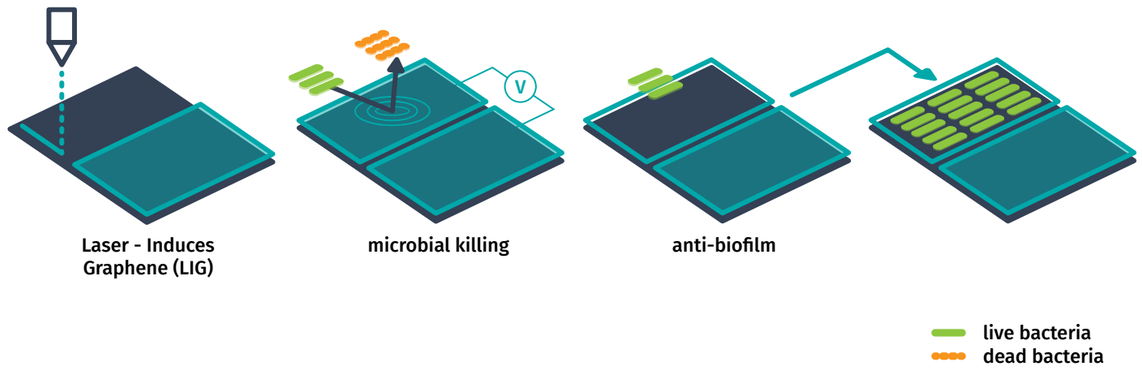
Scientists at Ben-Gurion University of the Negev, Israel, and Rice University, Houston, USA, have discovered that laser-induced graphene (LIG) is a highly effective antifouling material that, when electrified, becomes a "bacteria zapper." LIG is a spongy version of graphene – the single-atom layer of 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.

This year, we can update

Dr. Arnusch developed a portfolio of three patent families, based on his collaborative efforts with Prof. James Tour of Rice University. Their accomplishments are in the specialty field of Laser Induced Graphene (LIG).

Start-up companies in USA and Israel plan to develop the technology, focusing on products for water treatment, using the material's anti-biofilm/anti-fouling/ antibacterial properties.

Further applications are also envisaged, specifically those which are a function of the super-hydrophobic and super-hydrophilic nature of LIG, including desalination, membrane distillation, anti-icing, moisture collection, and oil-water separation.



Prof. Gabby Sarusi

Patent: **US -10126582B2**
Grant Date: **2018-11-13**
Invention Title: **'SWIR' to Visible Up - Conversion Optical System**
Inventors: **Ibrahim Abdulhalim; Gabby Sarusi**

Field of Invention:

The invention is from the field of photon up-conversion devices for converting images detected in short wavelength infrared light ['SWIR'] into images in the visible ['VIS'] wavelength range.

Abstract: The invention is an optical system for up-conversion of SWIR images into visible images. The optical system of the invention comprises a liquid crystal optically addressed spatial light modulator (LC-OASLM), which acts as an optical valve, and two optionally GRADIUM lenses to reduce the size and complexity of the optical setup. In embodiments of the invention, the photosensitive layer is replaced by a photodiode or array of photodiodes and the liquid crystal layer is replaced by an array (film) of organic light emitting diodes which emit light at the VIS by collecting SWIR light or by a fluorescence layer with sensitivity in the SWIR range.

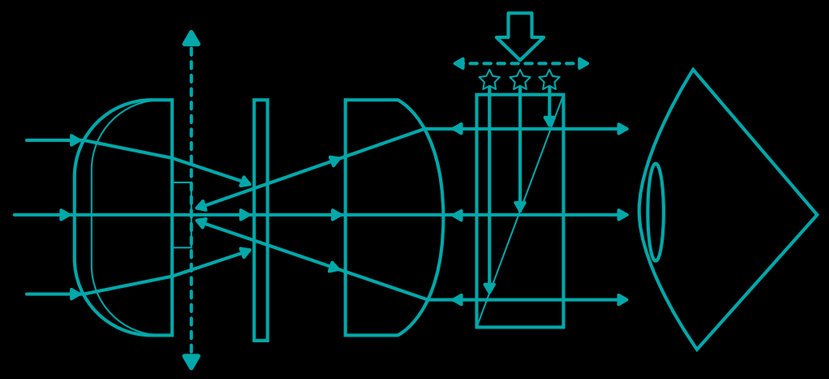
BGU Develops Technology to See in the Dark (March 15, 2018)

The Times of Israel — BGU researchers have developed a low-cost infrared sensor that can be used to create the world's thinnest night-vision glasses, as well as revolutionize smartphones and self-driving cars.

Prof. Gabby Sarusi in the BGU Unit of Electro-Optical Engineering and the Ilse Katz Institute for Nanoscale Science and Technology, has developed a double-sided stamp-like device. One side reads 1,500-nanometer infrared wavelengths and converts them to images that are visible to the human eye on the other side.

uspto.GOV
The United States Patent and Trademark Office
an agency of the Department of Commerce

Figure schematically shows the SWIR to visible up-conversion system of the invention. The optical setup is comprised of a first GRADIUM lens that functions in a similar manner to a Mirau objective lens.



'SWIR' to Visible Up - Conversion Optical System

Education

Educational activities of the IKI continued as appropriate in 2018, based on well-established precedent. This 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

4 outstanding students graduated from the IKI's specialized undergraduate nanotechnology program in 2018, based on a "double major" program in study, culminating in two distinct B.Sc. degrees: one in Chemistry and one in Chemical Engineering. (Separately, 8 students began their undergraduate studies – all with the highest credentials).

Doctoral Students

Nine years ago, the IKI made a decision to adapt to the highly interdisciplinary nature of nanoscience, initiating an interdisciplinary PhD degree program encouraging student mobility across traditional dividing lines.

In 2018, four students graduated from this program:

1 Dr. Orr Schlesinger

Dr. Orr Schlesinger was recruited by Evogene Ltd. as a Biochemistry Researcher (for advanced R&D). He is responsible for developing assays for screening and characterization of novel agro-chemicals to counter herbicide resistance and toxicity.

Evogene is a leading biotechnology company developing novel products for agriculture (Ag), through use of a unique computational biology platform (CPB). Their focus is on: seeds; specialized Ag-chemicals (herbicides, insecticides); and specialized Ag-biologicals (bio-stimulants)

2 Dr. Elad Segev

Dr. Elad Segev continues at BGU, working with IKI member, Prof. Guy Makov, in the framework of a short-term postdoctoral fellowship. They have already published several articles together on various topics related to newly discovered nanocrystalline semiconductors.

3 Dr. Dotan Davidovich

Dr. Dotan Davidovich was recruited by Skyline AI (skyline.ai).

4 Dr. Kobi Flomin

Three additional PhD students are anticipated to graduate from the program in 2019, and two new students started their doctoral research in the program this year.

Specialized Training & Customized Exposure

for Students in Selected Areas

- BGU Nanofabrication Center continued to carry out a variety of courses to the benefit of the BGU academic community. Classes from introductory to advanced, each uniquely specialized to demonstrate nanofabrication techniques for the students' specific fields of study. Micro-electro-mechanical systems (MEMS) devices seminar for mechanical engineering students. Nano-applications in energy and environmental engineering for desert studies M.Sc. students. Chemical vapor deposition (CVD) laboratory course for materials engineering students. Bio-sensing seminar for bio-medical engineering students. and hands-on introduction to cleanroom processes for electrical engineering and biotechnology engineering students.

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

- 4th year undergraduate students in materials engineering participated in an advanced teaching lab on nano-ceramics using advanced scientific techniques at the IKI, including electron microscopy, x-ray diffraction and x-ray Fluorescence spectroscopy.

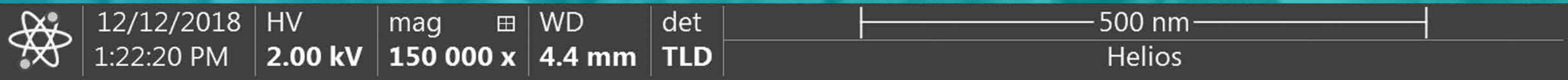
- The IKI continued the "open doors" policy, encouraging tours and training sessions in nanoscale materials characterization, with a special emphasis on analytical techniques.

- A special seminar took place on "Mass Spectrometry Applications at BGU" highlighting research results using the Mass Spectrometry facilities of IKI.

- A one day Vacuum course was presented by Kurt J. Lesker Company to IKI students and staff.

- "Amira-Avizo Software workshop" was conducted by Thermo Scientific company.

SEM plan-view image of Cadmium Sulfide (CdS) thin layer grown by Chemical Bath Deposition (CBD) technique (Prof. Gabby Sarusi group)



IKI Participates in a Leading
Pan-European Project Dedicated to

Nano Education

for Undergraduate & Graduate Students

iPEN Innovative Photonics Education in Nanotechnology

The iPEN project is dedicated to training students from non-physics background in the photonic processes and instrumentation featured and employed in nanotechnology laboratories.

iPEN offers a full offering of instruction based on courses and in-person workshops.

Moreover, the project highlights good teaching practices and makes use of training events during the course of the project lifetime specifically for staff training (this, in addition to student instruction). iPEN skillfully combines both modern on-line and off-line instructional frameworks. The iPEN consortium aims at developing hard skills (in photonics & nanotechnology) and soft skills (research methods, communicating results, etc.) of students which will increase their employability in any advanced working environment.

Funded by the Erasmus+ Programme of the European Union

National Erasmus Office Israel
http://www.erasmusplus.org.il/ipen
Erasmus = EuRopean Action Scheme for the Mobility of University Students

Several Representative On-Line Course Options

- An Introduction to Fundamental Optics
- An Introduction to Quantum Optics
- Optical Characterization of Solar Cells
- FTIR, UV – VIS Spectroscopy (Fourier-Transform Infrared Spectroscopy; Ultraviolet-Visible)

iPEN is a multinational consortium with partners from Greece, Italy, Germany, the Netherlands and Israel. The partners were chosen based on their strong records in photonics (both research and education) and in light of their expertise in various specialty fields within nanotechnology.

The project is funded under Key Action 2 (of the EC) - Cooperation for Innovation and the Exchange of Good Practices. iPEN was awarded €700,000 Euros in funding over a three-year period extending from Oct. 2017 through Oct. 2020.

The leader for BGU and the IKI is Dr. Raz Zarivach. Prof Ibrahim Abdulhalim and Dr. Iris Visoly-Fisher are participants. Dr. Visoly-Fisher leads a research group at BGU dedicated to Materials for Solar Energy Conversion and Storage. Her areas of expertise include Photovoltaics, Solar Energy, Surface Science, Scanning Probe Microscopy and Molecular Optoelectronics.

Special Event

IKI achieves a Major Presence at NANO.IL.2018

NANO.IL.2018
the leading international nanotechnology conference in Israel

http://www.nanoilconf.com

International Convention Center Jerusalem 9-11 October, 2018

The NANO.IL.2018 is a central meeting point for local and international companies, investors, universities, corporate research scientists and government representatives from around the world and is a unique platform bringing together elite speakers and top individuals from academia, business and government.

Session Chairpersons


Iris Visoly-Fisher


Yuval Golan


Taleb Mokari


Hanna Rapaport

BGU was widely represented at the conference, with:

7
Session Chairpersons

12
Speakers

59
Posters presented by our students

1
Commercialization booth exhibiting highlights of IKI activities.

Summary of Prestigious Competitive Research Grant (EC)
Project Acronym: ‘Cancer Scan’

A Body Scan for Cancer Detection Using Quantum Technology

Program: **European Innovation Council (EIC)**

Scheme: **FET - ‘Future Emerging Technology’**

Awardee: **Prof. Shlomi Arnon**

Affiliation: **Ilse Katz Institute for Nanoscale Science & Technology**

Purpose: **Novel Ideas for Radically New Technologies**

Project Coordiantor: **Ben-Gurion University**

Partners: **(1) Technical University of Munich (DE)**
(2) Sapienza University of Rome (IT)
(3) Medical University of Vienna (AT)

Objective:
With the ‘Cancer Scan’ project, Prof. Arnon, together with his international colleagues, plans to develop a radically new unified technological concept of biomedical cancer detection, utilizing cutting-edge ideas in quantum optics and quantum mechanics.

This project places BGU at the forefront of research aimed at integrating quantum science into medical applications. Recent technological advances allow scientists to control quantum systems and exploit quantum physics (e.g. quantum entanglement, superposition, etc.) in new ways and at new size scales, which were previously unimaginable to most.

The new concept developed by BGU researchers is based on non-invasive utilization of light and the unified transmission and detection of photons in multi-dimensional space. This project is expected to advance progress towards a revolutionary scanner capable of detecting cancer not only in a specified organ, but simultaneously in other parts of the body, even from remote locations, with no radiation risk whatsoever.

While applicable to cancer in general, the IKI pilot project will focus on the early detection of breast cancer.

The Future and Emerging Technologies (FET) programme aims at developing radically new technologies by exploring novel and high-risk ideas, building a scientific foundations. It promotes research beyound what is accepted or widely adobted and fosters visionary thinking to open promising paths towards powerful new technologies.

Biofouling Control

The German-Israel Water Technology Cooperation Program Call For Joint Proposals For 2018

in Reverse Osmosis / Nanofiltration Desalination with Novel Laser-induced Graphene Coated Polymeric Spacers

רשות החדשנות
Israel Innovation Authority

Deutsch-Israelische Zusammenarbeit
שיתוף פעולה גרמני-ישראלי
German-Israeli Cooperation

Bundesministerium für Bildung und Forschung

משרד המדע, הטכנולוגיה והחלל
MINISTRY OF SCIENCE, TECHNOLOGY & SPACE

Program:	**Water Technology Cooperation**
Scheme:	**BMBF (DE) MOST (IL)**
BGU PI:	**Dr. Christopher Arnusch**
Affiliation:	**Ilse Katz Institute for Nanoscale Science & Technology**
Purpose:	**Bilateral Coopearive Research in the Water Sector**

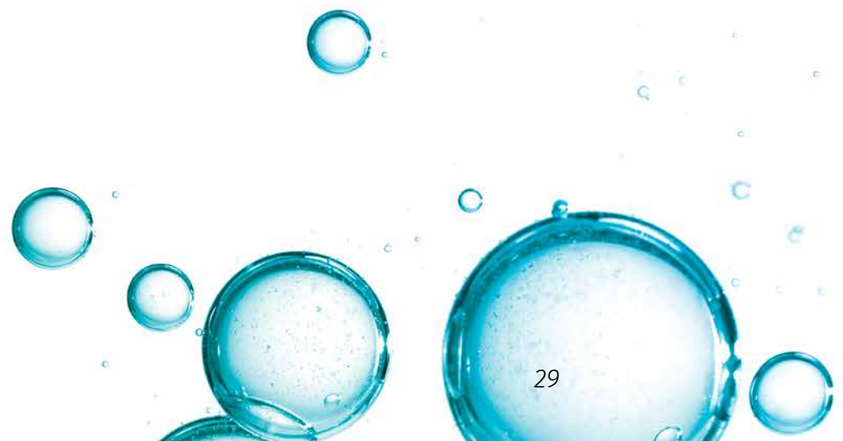
Objective:

Membranes are a critical element in the desalination process. As membranes are in permanent contact with seawater, they foul, and membrane spacers are particularly prone to biofouling. This drastically reduces the permeability, and thus the energy efficiency of the desalination process.

Laser-induced graphene (LIG) is an extremely fouling-resistant material, and configured as electrodes can generate H_2O_2 (hydrogen peroxide).

We propose to design antifouling polymer spacers coated with LIG that actively eliminate microbial growth inside the membrane module. LIG will be generated on polymer surfaces and the anti-biofouling and electrochemical behavior will be characterized in detail using advanced analytical microbial tracking methods, as well as micro electrochemical analysis.

The active anti-biofouling effects of LIG in a spiral wound membrane element will be a “game changer”. Furthermore, by unraveling the antifouling mechanism of LIG, advanced designs of potent antifouling surfaces will be possible.



SNaP SHoTs

Scalable Nano-Photonic Concepts and Stability of Hybrid Perovskite Semiconductors for Tandem Photovoltaics

BGU PI's: **Prof. Eugene Katz and Dr. Iris Visoly-Fisher Ilse Katz Institute for Nanoscale Science & Technology**

Purpose: **Bilateral Reseach Cooperation in Applied Nanotechnology**

Funded by: **German Federal Ministry of Education and Research (BMBF) Israel Innovation Authority (IAA)**

Objective:
The project focuses on three key objectives – all essential for the development of efficient and stable large-area hybrid tandem device technology:

Performance:
Improving light harvesting in hybrid tandem solar cells

Stability:
Achieving long-term stability evaluation and accelerated device testing

Scaling:
Scalable deposition and interface engineering of MHP/Br-polyaniline hybrid layers

German and Israeli Partner Organizations

HZB Helmholtz Zentrum Berlin

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

JCMwave

SolAround

Prof. Smadar Cohen | Nano Re Heart

Biomaterials and nanoparticles

for improved delivery of cell and protein therapeutics for heart repair

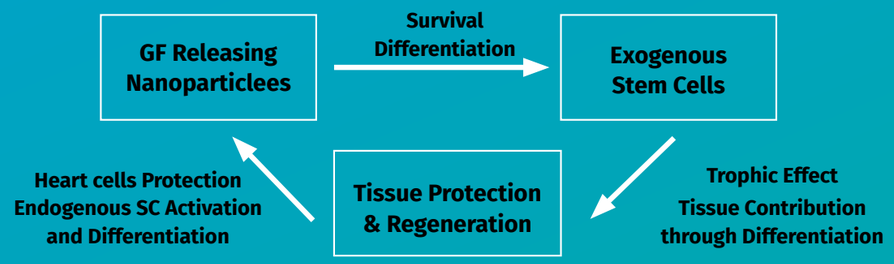
Acronym: **NanoReHeart**

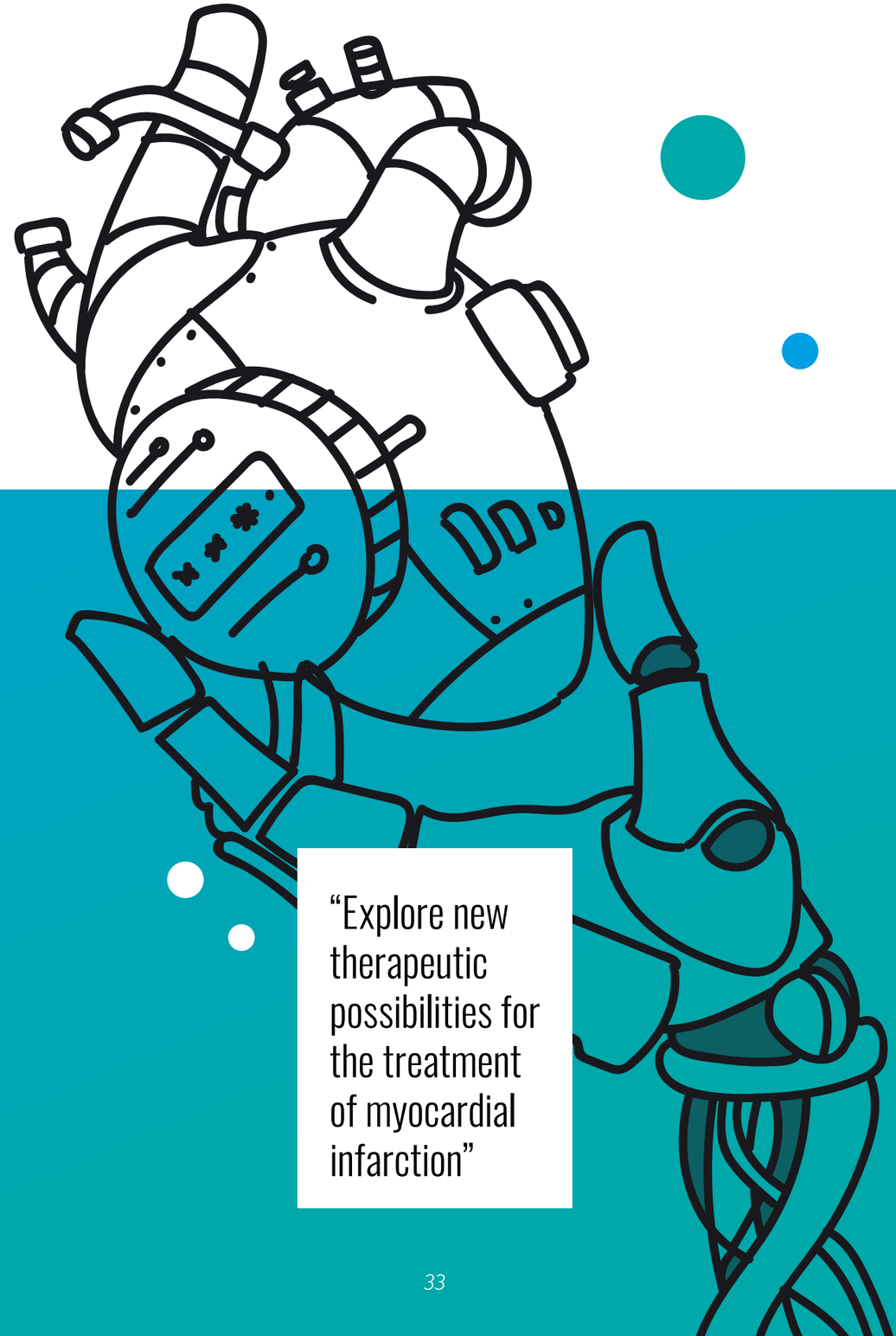
Coordinator: **Felipe Prosper, Clinica Universidad de Navarra, Spain**

Partners: **Stefan Jansens, Smadar Cohen, Beatriz Pelacho**

Objective:
The aim of this project is to explore new therapeutic possibilities for the treatment of miocardial infarction based on nanotechnology, biomaterials and stem cell therapy. The regeneration capability of factors stimulatory for stem/ progenito cells, angiogenesis and myogenesis (IGF and HGF) while administered as sustained release nanoparticles will be investigated. Furtheremore, adoptive transfer of stem/progenito cells from different sources, the blood and the adipose tissue will be also determined in an autologous preclinical porcine model of myocadrial infarction.

Improved delivery of cell and proteins for heart repair





"Explore new therapeutic possibilities for the treatment of myocardial infarction"

Recruitment of world class researchers

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

Dr. Muhammad Bashouti

The Dept. of Solar Energy and Environmental Physics, Ben-Gurion University of the Negev

Research Profile & Summary for New Scientific Investigator

Background:

Dr. Muhammad Bashouti began his academic career at the Hebrew University of Jerusalem, where he received his bachelor's degree in Chemistry. He then received a master's degree in Materials Chemistry from the Technion – Israel Institute of Technology. He continued at the Technion, and was awarded his doctoral degree in Physical Chemistry based on his theses "*Synthesis and Physical Characterization of Semiconductor Nanocrystals with Anisotropic Shape.*"

Dr. Bashouti has spent the last six years in Germany conducting nano-related research with appointments at both the Max-Planck Institute for the Science of Light, and Friedrich-Alexander University (FAU).

Research Approach:

Dr. Bashouti's research combines: (i) material development for optoelectronic applications; and (ii) surface functionalization/engineering. In the first part of the research, Dr. Bashouti develops broad nanowires and thin films-based optoelectronic devices such as solar cells, diodes, and Field Effect Transistors (FET). For this purpose, Dr. Bashouti developed his own silicon nanowire thin films incorporating gold flakes. In the second part of the research, Dr. Bashotui works to control the optoelectronic properties of the surface by developing nanoparticle-based passivation methods, and via the conversion of the surface phase.

Overarching Goal:

Unifying Dr. Bashouti's research is the quest to better understand the interactions between the molecule and the surface, with a particular focus on the optical and electronical properties before and after molecular coupling to the surface. Ultimately, Dr. Bashouti wants to invent new hybrid devices, and devise applications and energy production techniques that can meet societal needs.

B. Hoffmann
M. Y. Bashouti
T. Feichtner
M. Mačković
C. Dieker
A. M. Salaheldin
P. Richter
O. D. Gordan
D. R. T. Zahn
E. Spiecker
S. Christiansen

New Insights into Colloidal Gold Flakes: Structural Investigation, Micro-Ellipsometry & Thinning Procedure towards Ultrathin Monocrystalline Layers

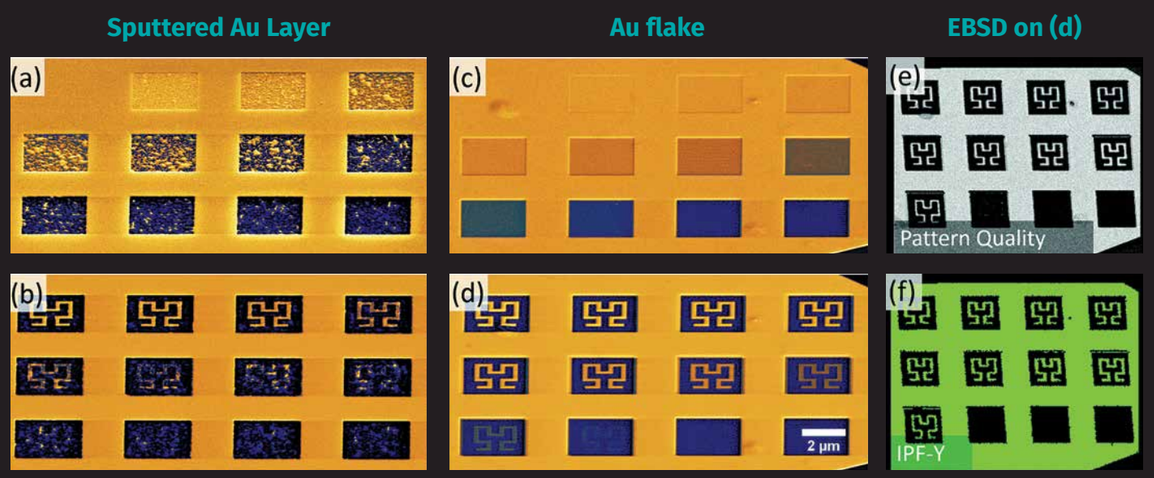
Abstract:

High-quality fabrication of plasmonic devices often relies on wet-chemically grown ultra-flat, presumably single - crystalline gold flakes, due to their superior material properties. However, important details about their intrinsic structure and their optical properties are not well understood yet.

In this study, we present a synthesis routine for large flakes with diameters of up to 70 µm and an in-depth investigation of their structural and optical properties.

The flakes are precisely analyzed by transmission electron microscopy, electron backscatter diffraction and micro-ellipsometry.

Scanning Electron Microscope (SEM) micrographs of structured gold layers:
etched rectangles in layers of sputtered nanocrystalline Au (a) and a monocrystalline Au flake (c) and subsequent nanostructuring of the layer (b) and the flake (d).



High Impact Publications

List of Publications with Impact Factor 10 and above

Wang X., Kong LH., Kong FX., Qiu FD., Xia MY., **Arnon S.,** Chen GH., *"Millimeter Wave Communication: A Comprehensive Survey"* **IEEE COMMUNICATIONS SURVEYS AND TUTORIALS**, 2018; Vol. 20, Issue 3, Pgs. 1616-1653. DOI: 10.1109/COMST.2018.2844322 [impact factor: 20.23]

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Gavriel R., Nadav-Tsubery M., Glick Y., Yarmolenko A., Kofman R., Keinan-Adamsky K., **Berman A.,** Mass T., Goobes G., *"The Coral Protein CARP3 Acts from a Disordered Mineral Surface Film to Divert Aragonite Crystallization in Favor of Mg-Calcite"* **ADVANCED FUNCTIONAL MATERIALS** 2018; Vol. 28, Issue 21, Article 1707321. DOI: 10.1002/adfm.201707321[impact factor: 13.325]

Ideses Y., Erukhimovitch V., Brand R., Jourdain D., Salmeron Hernandez J., Gabinet UR., Safran SA., Kruse K. and **Bernheim-Groswasser A.,** *"Spontaneous buckling of poroelastic actomyosin sheets"* **NATURE COMMUNICATIONS** 2018; Vol. 9, Article 2461 DOI:10.1038/s41467-018-04829-x [impact factor: 12.353]

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Convergent beam electron diffraction (CBED) pattern of
Zinc-oxide (ZnO) nano-wires grown on thermal silicon oxide.
(Dr. Ilan Shalish group)