NORTHWESTERN UNIVERSITY/TEL AVIV UNIVERSITY WORKSHOP
ENERGY, SUSTAINABILITY, AND BIOMATERIALS

NORTHWESTERN UNIVERSITY
SEPTEMBER 20–22, 2016

mccormick.northwestern.edu/nu-tau-workshop
mccormick.northwestern.edu/materials-science/
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David N. Seidman, Walter P. Murphy Professor of Materials Science and Engineering, Northwestern University
Noam Eliaz, Professor, Department of Materials Science and Engineering, Tel Aviv University

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Noam Eliaz, Professor, Department of Materials Science and Engineering, Tel Aviv University
Julio M. Ottino, Dean, Robert R. McCormick School of Engineering and Applied Science, Northwestern University
Yossi Rosenwaks, Professor and Dean, Faculty of Engineering, Tel Aviv University

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The Iby and Aladar Fleischman Faculty of Engineering, Tel Aviv University
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Northwestern
August 24, 2016

Dear Friends and Colleagues,

We are delighted to welcome you to the second Northwestern University – Tel Aviv University Workshop, 20 to 22 September 2016. This year the workshop is being held on the Evanston campus of Northwestern University, focusing on the themes Energy, Sustainability and Biomaterials, and a sub-theme on Water and Materials. Our first joint workshop was held at Tel Aviv University, 22 to 25 February 2015, on the themes Semiconductors, Electronic Materials, Thin Films and Photonic Materials.

In a joint white paper dated July 19, 2013, the departments of materials science and engineering at Northwestern University and Tel Aviv University proposed to collaborate on multiple levels. Their mutual interests are built on successful ongoing research collaborations between professors and their research groups at both institutions. Dedicated funding is, however, necessary to develop this international relationship to its absolute fullest. The first component of this collaboration is the organization of joint research workshops on focused themes, alternating between Tel-Aviv and Northwestern Universities.

At this workshop, all the Northwestern speakers are different from the ones who spoke at the Tel Aviv University workshop, 2015, and thus the Tel Avivians will be exposed to an increasingly broader range of materials science and engineering topics than was covered at the first NU-TAU workshop.

We are deeply appreciative of the following units at Northwestern University for their generous support of this joint workshop: McCormick School of Engineering and Applied Science; Global McCormick; Department of Materials Science and Engineering; Materials Research and Science Center (MRSEC); Department of Electrical Engineering and Computer Science; Chemistry Department, Provost’s Office; Office of Research; Crown Family Center for Jewish and Israel Studies. We are also thankful for the support of the Iby and Aladar Fleischman Faculty of Engineering and the Department of Materials Science and Engineering at Tel Aviv University.

We wish you a very highly productive, stimulating, enjoyable and sociable workshop, which will end on Thursday afternoon with an architectural boat ride on the Chicago River where you will experience some of the magnificent architecture of our beautiful city, which sits on the western shore of Lake Michigan. It is the largest lake in the world contained within one country, and also the fifth largest lake in the world; most of the lake shore property is public and, hence, can be enjoyed by all who visit it.

Yours respectfully,

Professors David Seidman (NU) and Noam Eliaz (TAU), Co-Chairs
July 7, 2016

Professor David Seidman
Department of Materials Science and Engineering
Northwestern University

Professor Noam Eliaz
Department of Materials Science and Engineering
Tel Aviv University

Dear David and Noam:

I am delighted to see that the workshop between Northwestern and Tel Aviv that you initiated last year will continue in the fall of 2016. The topics of energy, sustainability, and water are of enormous importance around the world, and I am confident that sharing the latest results between our two great universities will stimulate new ideas and research directions. International collaboration and cooperation is essential to tackle global challenges successfully, and discovering new materials will be a critical component of the solutions to these problems.

I look forward to hearing the outcomes of the workshop.

With my best wishes,

[Signature]
Daniel Linzer
Provost

July 2016

Dear Attendees,

It is my pleasure to welcome you to the 2016 Northwestern–Tel Aviv University workshops on semiconductors, electronic materials, thin films, and photonic materials.

Launched in February 2015, the NU- TAU workshops are structured to further scientific insight in these fields, as well as to enrich and expand existing research relationships. As you know, such collaboration is a hallmark of modern science — and it certainly is integral to how Northwestern’s discovery ecosystem operates. Some of the most exciting, promising, and high-impact breakthroughs happen at the intersections of our fields. Creating the infrastructure and incentives to further such investigation takes many forms, including this workshop itself.

The celebration of the second year of this joint initiative — hosted this time on our campus — is a milestone in Northwestern’s relationship with Tel Aviv University. It also demonstrates our respective commitment to international research collaboration and our vision that these efforts can produce pathbreaking results that improve the world. While in Evanston and Chicago, I invite you to tour our research facilities and learn more about the many innovations underway, including the significant expansion of our physical research footprint.

Thank you for investing your time and insights to make this endeavor a success. I wish you an intellectually engaging and enjoyable session!

[Signature]
Jay Walsh
Vice President for Research
Professor, Biomedical Engineering
July 25, 2016

Dear Attendees,

It is my great pleasure to welcome you to the second Northwestern University – Tel Aviv University Workshop, at the Evanston Campus of Northwestern University.

This international workshop series initiated from the mutual science and engineering interests and expertise, between the two institutions. The long-term goal of the workshops is to translate this strong intellectual foundation to sustainable collaborations, team science excellence, and development of new and innovative research avenues.

The inaugural Northwestern University - Tel Aviv University Workshop was held in 2015 at Tel Aviv University and focused on semiconductors, electronic materials, thin films and photonic materials. Fifteen investigators from each institution attended the workshop that led to fruitful scientific relationships. Building on the success of last year’s workshop, the scientific scope this year has expanded to energy, sustainability and biomaterials and includes a special theme of materials for water applications.

As an alumnus of Tel Aviv University, the close cooperation between the two Universities is of special and personal value to me. I support it wholeheartedly and will continue to contribute to the joint efforts to see it flourish.

I wish you stimulating and productive scientific sessions as well as enjoyable social events.

All the best,

Fruma Yehiel, Ph.D.
Associate Vice President for Research

August 15, 2016

Dear Participants,

The Crown Family Center for Jewish and Israel Studies is proud to support and co-sponsor the second scientific workshop and exchange: Energy, Sustainability and Biomaterials.

This project is a significant contribution to Israel Studies and the enduring relationship between Northwestern University and Tel Aviv University. The research presented will undoubtedly enrich the body of scientific research. I would like to commend the level of planning and coordination of Prof. David Seidman and Prof. Noam Eliaz, bringing together administrators, researchers, and students from both universities. Further, this workshop highlights the importance of developing scientific relationships between Northwestern and Israeli institutions of higher learning. It fulfills the Israel Studies Mission Statement to support "research based on academic diligence and interdisciplinary approaches" and to promote "Israeli technological and scientific scholarship." At a time when calls to boycott Israeli universities are being voiced in various US campuses such ventures are doubly important.

Earlier this year, Israel Studies and the Northwestern Center for Water Research at the McCormick School of Engineering collaborated to develop an interdisciplinary seminar course and symposium on “Water in Israel and the Middle East.” The third day of the workshop is dedicated to new research in hydrology and water treatment and serves therefore as a continuation and expansion upon topics from the spring’s water symposium. Bringing together international scholars, students and the community creates public discussion on these important issues and promotes the important research conducted by the respective workshop participants.

I look forward to the successes of the Materials Science Workshop and future exchanges of resources and research between Northwestern and institutions such as Tel Aviv University.

Sincerely,

Prof. Elie Roche
Associate Director for Israel Studies
Crown Family Center for Jewish and Israel Studies
Northwestern University
Dear Attendees,

It is my pleasure to welcome you to Northwestern’s McCormick School of Engineering and Applied Science for the second Northwestern University-Tel Aviv University joint workshop.

Collaboration between our institutions is growing rapidly. I hope that this workshop will serve as another catalyst for partnership as we explore pressing issues in energy, sustainability, and biomaterials. Our institutions bring unique perspectives, but share a common passion for advancing science and engineering.

I hope that you enjoy your time in Evanston and have the chance to explore parts of Northwestern’s campus. I wish you a productive and invigorating workshop.

Best regards,

Julio M. Ortino
Dean
R. R. McCormick Institute Professor
Walter P. Murphy Professor of Chemical and Biological Engineering

July 2016

August 4, 2016

Dear Attendees,

It is my pleasure to welcome you to the 2016 Northwestern University-Tel Aviv University workshop on energy, sustainability, and biomaterials with a subtheme on water and materials.

There is great synergy between the scientific scope of the workshop and the Northwestern University Materials Research Center to advance cross-disciplinary materials science research, collaboration, and commercial innovation. First established in 1959, the Center has received continual external funding and has been a signature unit on campus to create the infrastructure and programs in materials research and education that transform society.

I invite you to learn more about our Center and its diverse research portfolio and facilities during your visit to Northwestern. I wish you a productive and intellectually stimulating workshop.

Best regards,

Mark C. Hersam
Director, Materials Research Center
Walter P. Murphy Professor of Materials Science and Engineering
Professor of Chemistry, Medicine, and Electrical Engineering (by courtesy)
Dear Participants,

Tel Aviv University’s blossoming relationship with Northwestern has opened diverse opportunities for collaborative projects in areas ranging from business and law to medicine, engineering and the exact sciences. No less important are the new and unique opportunities for partnerships with the Chicago-area academic and business communities – and with alumni of both universities – to support this dynamic activity.

I am pleased to see that following the success of last year’s inaugural joint workshop held at Tel-Aviv University, a second joint workshop is taking place this year at Northwestern University. The theme of this year’s workshop - Energy, Sustainability and Biomaterials, with a sub-theme on water and materials - is very timely and of great importance to the whole world.

I hope that new scientific collaborations will evolve from this joint workshop, as has happened in the aftermath of the first workshop.

I would like to stress that we take pride in our association with Northwestern University. We are especially proud of our shared, ongoing contribution to Israeli-American academic links and to our two countries’ close friendship.

I wish you a rewarding and enjoyable workshop and look forward to continuing this cooperative endeavor for many years.

Sincerely,

[Signature]

Professor Joseph Klafter
President
June 30, 2016

Dear participants, colleagues and friends,

It gives me a great pleasure to welcome you all to the second Northwestern University and Tel Aviv University Joint Workshop. This workshops series is an important step in enhancing the scientific collaboration between the two universities at all levels of research and teaching.

Both universities share the same global challenges, goals and responsibilities. Future science and education will be strongly based on the concepts of information and networks, multidisciplinary research and teaching, outreach and the implications for the society. Both universities have already made a major impact in all these areas. With a joint work we can take these to new heights.

I am looking forward to hearing the scientific news from the workshop and the future plans for continuation.

With best wishes,

Prof. Yaron Oz
Rector

June, 2016

Dear colleagues,

In continuation of the excellent working relationship and strategic partnership existing between Tel Aviv University and Northwestern University, I take pleasure in welcoming the second joint workshop of September 2016.

Joint partnerships for research and innovation activities are one of the major priorities of all world-class universities and act as a critically important bridge builder between global academia and their respective nations, where all boundaries are gone.

This second joint workshop represents a cause for celebration; owing to the vision and commitment of the academic leadership on both sides of the Atlantic, the agreement signed a few years ago between our two institutions has generated a wide variety of collaborative endeavors, joint research, study programs and student exchange across diverse disciplines and departments that have strengthened our bilateral relationship. From the Law School to the Business School, from Film and Television studies to Israel studies, the purple color of Northwestern University, seen all over our campus, attests to the vitality of its presence.

This joint workshop on Energy, Sustainability and Biomaterials, represents a further milestone in our valued relationship, bringing together leading researchers from the Iby and Aladar Fleischman Faculty of Engineering, the George S. Wise Faculty of Life Sciences, the Lester and Sally Entin Faculty of Humanities, the McCormick School of Engineering and Applied Science and the Weinberg College of Arts & Sciences.

I would like to thank the organizers and participants in this workshop, especially Professors David Seidman and Noam Eliaz, and wish you all a productive meeting.

Sincerely,

Prof. Raanan Rein
Vice President
Dear Friends and Colleagues,

I am honored to be part of the esteemed delegation of Professors from our University to the second Northwestern-Tel-Aviv universities workshop. This year the workshop focuses on Energy, Sustainability and Biomaterials with a sub-theme on water and materials. These topics are not only scientifically exciting, but are of utmost importance to Israel, and I am sure this will be discussed and reflected in the workshop.

I am sure that David and Noam will put together a very high level program that will expose top scientists from both institutes to the state-of-the-art research in the above topics, and I again grateful to them of organizing this event. There are already several ongoing collaboration between the two faculties, and even some that were initiated following the last meeting in Tel-Aviv. We all hope that the coming workshop will lead to additional collaborations between the two institutes and I am looking forward to see you all in Evanston in September 2016.

Sincerely,

Prof. Yossi Rosenwaks
Dean
PROGRAM

TUESDAY, SEPTEMBER 20
Guild Lounge
Scott Hall, Northwestern University, 601 University Place, Evanston, IL 60202
northwestern.edu/norris/events/satellite-venues/guild-lounge/index.html

8:30 - 9:00 am OPENING SESSION
Prof. David N. Seidman – Co-Chair of workshop, NU
Prof. Jay Walsh – Vice President for Research, NU
Prof. Matthew Grayson – EECS and Director of Global Initiatives
Prof. Noam Eliaz – Co-Chair of workshop, TAU

SESSION CHAIR: Prof. David N. Seidman (MS&E, NU, Director of NUCAPT)

9:00 - 9:30 am Dr. Fruma Yehiely (Associate Vice President for Research, NU)
Collaborative funding opportunities

9:30 - 10:00 am Prof. Yossi Rosenwaks (Dean of Engineering, EE and MS&E, TAU)
Electrostatically formed nanowires: a platform for sensors, transistors and electronic devices

10:00 - 10:30 am Prof. Samuel I. Stupp (MS&E and FSM, NU)
Supramolecular energy materials and biomaterials

10:30 - 10:45 am COFFEE BREAK

SESSION CHAIR: Prof. Selim Shahriar (EECS, Applied Physics, Physics, NU)

10:45 - 11:15 am Prof. Amit Kohn (MS&E, TAU)
Mapping charge distribution in nanoscale ionic materials by electron holography

11:15 - 11:45 am Prof. Chris Wolverton (MS&E, NU)
Experimental approaches to computational design of nanostructured thermoelectrics

11:45 - 12:15 am Prof. Vinayak P. Dravid (MS&E and Director NUANCE Center, NU)
Electromicroscopy of energy materials

12:15 - 12:45 pm Dr. Oswaldo Diéguez (MS&E, TAU)
Atomistic simulation of ferroelectric and multiferroic perovskite oxides

12:45 - 1:45 pm LUNCH BREAK

SESSION CHAIR: Prof. James Rondinelli (MS&E, NU)

1:45 - 2:15 pm Prof. Ilan Goldfarb (MS&E, Director WAMRC, TAU)
Hysteretic switching in nanomagnets and memristors from a material science perspective

2:15 - 2:45 pm Prof. Hooman Mohseni (EECS, NU)
Selective coupling of optical modes and matter

2:45 - 3:15 pm Prof. Noam Eliaz (Chair MS&E, TAU)
Electrochemically deposited calcium phosphate coatings for dental and orthopedic implants – from fundamental studies to the clinics

3:15 - 3:45 pm Prof. Derk Joester (MS&E, NU)
Chemical imaging of interfaces and interphases in tooth biominerals

3:45 - 4:00 pm COFFEE BREAK

SESSION CHAIR: Prof. Bruce Wessels (MS&E, NU)

4:00 - 4:30 pm Prof. Jacob (Koby) Scheuer (EE, TAU)
Reconfigurable metamaterials and photonic crystals

4:30 - 5:00 pm Prof. Tamar Seideman (Chemistry, NU)
Role of strong plasmon-sensitizer coupling in solar cells

5:00 - 5:45 pm BREAK

5:45 pm Shuttle departs the Hilton Orrington Hotel for Banquet
Hilton Orrington Hotel: 1710 Orrington Avenue, Evanston, IL 60201 (hotelorrington.com)
Banquet at Shallots Bistro: 7016 Carpenter Rd., Skokie, IL 60077 (shallotsbistro.com)
After dinner, the shuttle returns to the hotel.
WEDNESDAY, SEPTEMBER 21

Scott Hall, Northwestern University, 601 University Place, Evanston, IL 60202
northwestern.edu/norris/events/satellite-venues/guild-lounge/index.html

8:30 - 8:50 am OPENING SESSION
Prof. Daniel Linzer – Provost, NU
Prof. Julio Ottino – Dean of the Robert R. McCormick School of Engineering and Applied Sciences (MEAS), NU
Prof. Mark Hersam – Director of the Materials Research Science and Engineering Center, (MS&E, Chemistry, EECS, FSM)
Prof. Elie Rekhess – Associate Director, Crown Family Center for Jewish and Israel Studies

SESSION CHAIR: Prof. Michael Bedzyk (MS&E, NU)

8:50 - 9:20 am Prof. John A. Rogers (MS&E and FSM, NU)
Materials for bioresorbable electronics

9:20 - 9:50 am Prof. Shachar Richter (MS&E, TAU)
Bio-inspired photovoltaics

9:50 - 10:20 am Prof. Tal Dvir (Biotechnology and MS&E, TAU)
Cardiac tissue engineering: from matrix design to the engineering of cyborg tissues

10:20 - 10:30 am COFFEE BREAK

SESSION CHAIR: Prof. G. Jeffrey Snyder (MS&E, NU)

10:30 - 11:00 am Prof. Ramille N. Shah (MS&E and FSM, NU)
Expanding the 3D printable biomaterial palette: new approaches to material design and development

11:00 - 11:30 am Prof. David Dunand (MS&E, NU)
Metallic scaffolds by reduction of 3D-printed oxide inks

11:30 am - 12:00 pm Dr. Brian A. Rosen (MS&E, TAU)
Influence of LaNiO₃ structure on its solid-phase crystallization into methane reforming catalysts

12:00 - 12:30 pm Prof. Arie Ruzin (EE, TAU)
Compensated semiconductors: Calculations and experimental results

12:30 - 2:00 pm LUNCH BREAK – personal discussion of research

SESSION CHAIR: Prof. Kenneth Shull (MS&E, NU)

2:00 - 2:05 pm Prof. Erik Luijten (Chair, MS&E; ESAM, NU)

2:05 - 2:35 pm Prof. Tobin J. Marks (Chemistry and MS&E, NU)
Designer materials for printed flexible hybrid electronic circuitry

2:35 - 3:05 pm Prof. Robert P.H. Chang (MS&E and EECS, NU)
Dynamic interaction of light with indium tin oxide nano-rod arrays in the near infrared

3:05 - 3:35 pm Prof. Scott A. Barnett (MS&E, NU)
3D tomography of fuel cell and battery electrodes: electrochemical performance and long-term durability

3:35 - 3:50 pm COFFEE BREAK

SESSION CHAIR: Prof. Mark Hersam (MS&E, EECS, Chemistry, FSM, Director of MRSEC, NU)

3:50– 4:20 pm Dr. Ariel Ismach (MS&E, TAU)
2D materials: synthesis of flat and 3D structures

4:20 - 4:50 pm Prof. Kimberly A. Gray (CE&E, NU)
Novel nano-architectures: water, energy & health

4:50 – 5:20 pm Dr. Noa Lachman (MS&E, TAU)
Carbon nanotubes nanocomposite morphology tailoring (for energy storage)

5:20 – 5:50pm Prof. Mark A. Ratner (Chemistry and MS&E, NU)
International Institute for Nanotechnology (IIN), Nanoscience and Nanotechnology in Israel, and Returning

5:45 pm - Free evening and time for personal communications
**THURSDAY, SEPTEMBER 22**

**Guild Lounge**
Scott Hall, Northwestern University, 601 University Place, Evanston, IL 60202
northwestern.edu/norris/events/satellite-venues/guild-lounge/index.html

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**SESSION CHAIR:** Prof. Yip-Wah Chung (MS&E, NU)

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<th>Time</th>
<th>Speaker</th>
<th>Title</th>
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<tr>
<td>8:30 - 9:00 am</td>
<td>Prof. Dror Avisar (Head, Water Research Center – Hydrochemistry, TAU)</td>
<td>The removal and breakdown of chemotherapy drugs derived from hospital wastewater using based ozone AOP technology – a pilot scale project at Tel-HaShomer hospital, Israel</td>
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<td>9:00 - 9:30 am</td>
<td>Prof. Aaron I. Packman (CE&amp;E, Director Center for Water Research, NU)</td>
<td>Biofilms, biofouling and biomineralization: structural controls on microbial colonization and eradication in water systems and medical devices</td>
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<td>9:30 - 10:00 am</td>
<td>Prof. Hadas Mamane (Mech Eng, TAU)</td>
<td>Application of nanostructured solar photocatalytic membrane reactors (PMRs) for water treatment</td>
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<th>Time</th>
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<td>10:00 am - 1:15 pm</td>
<td>Free for personal meetings and laboratory tours</td>
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<tr>
<td>1:30 pm</td>
<td>Departure of shuttle from the Hilton Orrington Hotel to the Boat Cruise</td>
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<tr>
<td>3:00 - 4:30 pm</td>
<td>Chicago River Architecture Boat Cruise</td>
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<tr>
<td>6:00 pm -</td>
<td>Dinner at Cohen Commons Faculty and Staff Dining Room Room L482, 4th floor North, Technological Institute, 2145 Sheridan Rd.</td>
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**GENERAL INFORMATION**

**VENUE**
Northwestern University, Evanston, IL USA
All workshop presentations will take place in Guild Lounge located at:
Scott Hall, Northwestern University, 601 University Place, Evanston, IL 60202
For more information, please visit: northwestern.edu/norris/events/satellite-venues/guild-lounge

**HOTEL**
The Hotel Orrington is a seven-minute walk to the Guild Lounge. Rooms are non-smoking and come with wireless high speed internet. Breakfast is not included. Continental breakfast will be provided at the Guild Lounge. For additional hotel information, please visit: hotelorrington.com

**ABSTRACTS**
The conference program and abstracts are available on the NU-TAU Workshop website:
mccormick.northwestern.edu/nu-tau-workshop

**MEALS**
The Tuesday banquet will take place at Shallots Bistro (7016 Carpenter Rd., Skokie, IL 60077, shallotsbistro.com). A shuttle service will take attendees to and from the restaurant. Shuttle pickup for dinner from the Hotel Orrington will take place at 5:45 p.m.
There is no dinner planned for Wednesday night. Guests are welcome to experience any restaurant of their choice. Please refer to the Chicago's Northshore Official Visitors Guide for restaurant options and locations or visit:
downtownevanston.org
The Thursday banquet will be held at 6 p.m. in the Cohen Commons Faculty and Staff Dining Room located in room L482 on the 4th floor of the Technological Institute, 2145 Sheridan Rd. No shuttle service will be provided from the hotel.

**EVENTS**
Conference attendees are invited to participate in a Chicago Architectural Boat Cruise on Thursday, September 22. A shuttle will pick attendees up at 1:30 p.m. at the Hotel Orrington, and drop attendees off at the Hotel Orrington following the cruise.

**OTHER INFORMATION**
- Complimentary wireless high-speed internet is available throughout the Northwestern University campus.
- Choose “Guest-Northwestern” in the list of networks presented. During registration, accept the University’s acceptable use policy and provide your contact information and the name of the organization (“McCormick”) sponsoring your University visit.
- Please wear your name badge at all workshop events.

NU-TAU 2nd Workshop Program Energy, Sustainability, and Biomaterials
COLLABORATIVE FUNDING OPPORTUNITIES
Fruma Yehiely, PhD
Associate Vice President for Research, Office for Research, Northwestern University
yehiely@northwestern.edu
research.northwestern.edu

ABSTRACT
The presentation will review potential collaborative funding opportunities that will enable Northwestern University and Tel Aviv University researchers to promote joint team programs.

BIOGRAPHY
Dr. Yehiely received her PhD from the Weizmann Institute of Science, and her post-doctoral training at the University of California San Francisco.

Dr. Yehiely has performed in parallel research and administrative roles at the University of Illinois at Chicago and at Northwestern University. She managed breast cancer and apoptosis research programs and mentored numerous post-docs and graduate students. She authored many peer reviewed publications and has been an invited speaker at national conferences. Dr. Yehiely managed multi-million dollars industry and federal sponsored grants and contracts, coordinated international studies, and consulted to biotech on proprietary mammalian gene discovery. She is an inventor on two patents related to anti-cancer drug targets.

In 2008 Dr. Yehiely joined the Division of Fertility Preservation as the founding Director for Research Administration and in 2010 she became the Director of Research Development, in the Office for Research where she worked with faculty and senior leadership to catalyze new programs across Northwestern including the development of complex, interdisciplinary, grant proposals to the NSF, NIH, DoD and DoE.

As an Associate Vice President for Research, Dr. Yehiely facilitates institutionally strategic new initiatives including expansion of domains of excellence, facilitating new national and international partnerships, and promoting a culture of interdisciplinary research across Northwestern.

ELECTROSTATICALLY FORMED NANOWIRES:
A PLATFORM FOR SENSORS, TRANSISTORS AND ELECTRONIC DEVICES
Prof. Yossi Rosenwaks
Faculty of Engineering, Tel Aviv University
yossir@eng.tau.ac.il
eng.tau.ac.il/~yossir

ABSTRACT
As transistors dimensions are to reach their fundamental limit in around 2025, new design concepts are a subject of utmost importance. We present here a new paradigm in nanowire based devices termed Electrostatically Formed Nanowires (EFN). We demonstrate its application as a gas sensor, and multiple state transistor. We show that the EFN can function as an extremely sensitive molecular and temperature sensor, and in various electronic applications.

BIOGRAPHY
Prof. Yossi Rosenwaks, Dean of the Faculty of Engineering, and the head of Tel Aviv University’s Center for Renewable Energy, has been a professor of electrical engineering at TAU since 2005 after joining the faculty in 1996. He served as the president of the Israel Vacuum Society (2003-2008), and as the director of TAU’s Wolfson Center for Applied Materials Research and Gordon Center for Energy Studies (2005-2008), and the head of the Physical Electronics department 2011-4. Prof. Rosenwaks leads a research group of 10 graduate students and scientists, and his current research interests include nanoscale electrical measurements using mainly Kelvin probe force microscopy, nanowire transistors and sensors, charge carrier dynamics and transport in semiconductors, and Kelvin probe microscopy of 2D materials.
SUPRAMOLECULAR ENERGY MATERIALS AND BIOMATERIALS

Samuel I. Stupp
Board of Trustees Professor, Departments of Materials Science and Engineering; Chemistry, Medicine, and Biomedical Engineering; Director, Simpson Querrey Institute for BioNanotechnology; Director, Center for Bio-Inspired Energy Science, Northwestern University
s-stupp@northwestern.edu
stupp.northwestern.edu

ABSTRACT
Supramolecular soft matter has the potential to mimic the structures and dynamics of biological systems, and it is therefore a rich platform for the development of bio-inspired materials. The interesting features of supramolecular soft materials include, nanoscale control of dynamics, highly responsive behavior to external stimuli, capacity to self-heal defects, noncovalent co-localization of functional domains, and the use of self-assembly to optimize function. Among many others, this lecture will first describe supramolecular soft materials that mimic the photosynthetic machinery in biological systems by integrating the necessary functions to generate solar fuels. As a second topic, the lecture will discuss the development of highly dynamic bioactive supramolecular materials for biomedical applications. These materials mimic the architecture of extracellular matrices and have the capacity to promote regeneration of tissues by interacting with cells and triggering biological signaling pathways. The third topic to be covered is the integration of covalent and supramolecular polymers to create artificial muscle materials and self-repairing structures.

BIOGRAPHY
Samuel Stupp is Board of Trustees Professor of Materials Science and Engineering, Chemistry, Medicine, and Biomedical Engineering at Northwestern University. He directs at Northwestern the Simpson Querrey Institute for BioNanotechnology and the Energy Frontiers Research Center for Bio-Inspired Energy Science funded by the Department of Energy. Professor Stupp is a member of the National Academy of Engineering, the American Academy of Arts and Sciences, and the Spanish Royal Academy. He is a fellow of the American Physical Society and the Materials Research Society, and his awards include the Department of Energy Prize for Outstanding Achievement in Materials Chemistry, the Materials Research Society Medal Award, the American Chemical Society Award in Polymer Chemistry, the American Chemical Society Ronald Breslow Award for Achievement in Biomimetic Chemistry, and the International Award from The Society of Polymer Science in Japan. He has received honoris causa doctorates from Eindhoven Technical University in the Netherlands, the University of Gothenburg in Sweden, and the National University of Costa Rica.

MAPPING CHARGE DISTRIBUTION IN NANOSCALE IONIC MATERIALS BY ELECTRON HOLOGRAPHY

Amit Kohn
Department of Materials Science and Engineering, Tel Aviv University
akohn@tauex.tau.ac.il

ABSTRACT
Charge redistribution in nanoscale ionic crystals has an important role on their functional properties. Although theoretical advances have been achieved, experimental evidence is mostly indirect. I will present applications of electron holography and electron energy-loss spectroscopy in the transmission electron microscope to map charge redistribution in two such cases.

The first case is non-stoichiometric nano granular spinel for which we show that the space charge potential and grain boundary segregation are controlled by excess cation species. When grain dimensions are reduced to the Debye length, grain cores are electrically charged. Moreover, by applying an electric field during sintering, the magnitude of the space charge potential is decreased.

The second case is a semiconducting hybrid of a PbS core and CdS arms that exhibit epitaxial relations. In these nanoscale structures, fluorescence emission from the CdS arms is quenched, attributed to energy band alignment with respect to the PbS core. Off-axis electron holography of single structures compared to 3-dimensional Poisson simulations indeed show a Type I interface in which the electric field is mostly redistributed on the CdS arm, causing charge carriers to separate and prevent recombination.

BIOGRAPHY
Amit Kohn is an Associate Professor at the Department of Materials Science and Engineering at Tel Aviv University since last October. Amit’s research projects are in the field of magnetic and electronic materials used for information storage devices. The contribution of the research is to relate between structure and composition of these materials to the magneto-transport properties of the devices. The objective is therefore to improve on, or design new so-called ‘spin-electronic’ devices.

Structural and chemical characterization is mostly achieved by analytical transmission electron microscopy, which probes the properties of the materials at the nanoscale and up to the atomic level. In addition, Amit applies and develops Lorentz electron microscopy and electron holography in order to image magnetic and electrostatic fields in materials and devices at the nanometre scale.

Prof. Kohn holds a Ph.D. in Materials Engineering from the Technion – I.I.T. He was a Royal Academy of Engineering Research Fellow at the Materials Department, University of Oxford followed by a faculty position at Ben-Gurion University of the Negev.
MATERIALS GENOME APPROACH TO COMPUTATIONAL DESIGN OF NANOSTRUCTURED THERMOELECTRICS

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ABSTRACT
Creating nanostructures within alloyed bulk thermoelectric materials can greatly decrease the lattice thermal conductivity of the material and thereby increase the thermoelectric efficiency of these materials. However, the rational design of thermoelectric alloys with even larger figures of merit will require a quantitative knowledge of the electronic and thermal properties and phase stability of nanostructured semiconductor materials. I will present key examples to show how first-principles based calculations can reveal the intricate but tractable relationships between properties for optimization of thermoelectric performance. The integrated optimization includes significant reduction of the lattice thermal conductivity with multi-scale hierarchical architecturing, large enhancement of Seebeck coefficients with intra-matrix electronic band convergence engineering, and control of the carrier mobility with band alignment between host and second phases. These techniques can simultaneously enhance the power factor and reduce the lattice thermal conductivity, thereby leading to high efficiency thermoelectric materials.

BIOGRAPHY
Chris Wolverton is a Professor of Materials Science and Engineering at Northwestern University. Before joining the faculty, he worked at the Research and Innovation Center at Ford Motor Company, where he was group leader for the Hydrogen Storage and Nanoscale Modeling Group. He received his BS degree in Physics from the University of Texas at Austin and his PhD degree in Physics from the University of California at Berkeley. After completing his PhD degree, Wolverton performed postdoctoral work at the National Renewable Energy Laboratory (NREL). His research interests include computational studies of a variety of energy-efficient and environmentally friendly materials via first-principles atomic calculations, high-throughput and data mining tools to accelerate materials discovery, and “multiscale” methodologies for linking atomistic and microstructural scales. Wolverton has authored or co-authored more than 200 peer-reviewed publications (h-index=55), holds nine patents (several others pending), and has given more than 150 invited talks. Wolverton is a Fellow of the American Physical Society, has won the Walder publications (h-index=55), holds nine patents (several others pending), and has given more than 150 invited talks. Wolverton is a Fellow of the American Physical Society, has won the Walder

ELECTRON MICROSCOPY OF ENERGY MATERIALS

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ABSTRACT
The global energy portfolio must include not only supply side of energy but also demand/efficiency and storage. The common denominator associated with such energy materials revolves around conversion, transport and storage of charge, mediated by microstructure of material across varied length-scales; from atomic to micro to meso-scale, and even wider temporal range from femto-second electron transfer to slow ionic diffusive processes.

Electron microscopy, especially in-situ electron microscopy under applied stimulus has the potential for revealing atomistic details of energy conversion/storage phenomena. We have utilized both ex-situ and in-situ electron microscopy to observe and analyze dynamics of energy materials. In specially designed experiments with applied bias, we have examined dynamics of ion transport and reaction (of Li and Na) in Li/Na-ion batteries. We have observed intricacies of reaction and intercalation mechanisms at atomic resolution under dynamic conditions. The presentation will cover observations and analysis of dynamic phenomena in energy materials, and present opportunities for collaborative work between NU and TAU in this important field for materials research. The role of facility infrastructure will be emphasized in the context of education, research and outreach as well as an anchor for global collaborations.

BIOGRAPHY
Vinayak P. Dravid is Professor of Materials Science and Engineering and founding Director of the NUANCE Center (NU Atomic and Nanoscale Characterization Experimental) Center. He received his B.Tech. from IIT Bombay in 1984, and PhD from Lehigh University in 1990.

Vinayak has a diverse research portfolio covering advanced microscopy, nanotechnology, technology strategy, policy and emerging educational paradigms. He has authored over 480 journal publications and holds more than two dozen issued/pending patents.

Vinayak’s awards/honors include Fellowships to many societies: American Physical Society (APS), American Association for Advancement of Science (AAAS), Materials Research Society (MRS), the Microscopy Society of America (MSA, inception class), and the American Ceramic Society (ACerS). He is the recipient of several awards; the American Ceramic Society’s Robert L. Coble Award and Richard M. Fulrath Award, MSA’s Burton Medal, IBM’s Faculty Development Award, NSF’s Young Investigator Award. He is an honorary life-member of MRS India and Hsuen Lee fellow of the Chinese Academy of Science. Vinayak has been elected to Northwestern’s Faculty Honor Roll for excellence in teaching by UG students. One of Vinayak’s passions is to enhance societal and global appreciation for science and technology, especially of microscopy, materials science, nanotechnology, and energy/sustainability.
HYSTERETIC SWITCHING IN NANOMAGNETS
AND MEMRISTORS FROM A MATERIAL SCIENCE PERSPECTIVE

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ABSTRACT
Controllable repeated switching between two (or more) states is a scientifically interesting and technologically important phenomenon, for example in the field of non-volatile random access memories. Switching material would often exhibit hysteretic behavior of one of its fundamental properties, such as charge, spin, striction, etc. In this talk I will survey our recent work on nanomagnets and on resistive switching. For the nanomagnets we use self-organized epitaxial islands of transition-metal silicides (TMS) and also started experimenting with rare-earth metal silicides (RMS). Transition-metal oxides (TMO) play an increasingly important role in contemporary devices and oxide electronics, in particular in memristor technology for resistive switching. By combining in situ chemical state and electronic band structure studies from x-ray photoelectron spectroscopy (XPS) with temperature-dependent transport measurements, we explored the relationship between electronic structure and conduction mechanisms in thin sputtered films of three representative binary Me-O (Me=Ta, W, and Nb) systems, as a function of oxygen content. These amorphous films displayed Fermi glass behavior following an oxidation-induced transition from metallic to hopping conduction, down to a sub-percolation threshold. The hopping sites were created by neutral in-plane oxygen vacancy defects and their localization estimated from the band structure was in agreement with that from the transport measurements.

BIOGRAPHY
Ilan Goldfarb is a Full Professor at the Department of Materials Science and Engineering at Tel Aviv University. After obtaining his doctorate in growth and transmission electron microscopy of thin multilayered films with Prof. Shechtman at Technion's Department of Materials Engineering in 1994, he joined the Department of Materials Science and Engineering of Tel Aviv University in 2013, where he is a senior lecturer (assistant professor). His research involves studying the properties of materials by modelling the behavior of their electrons and nuclei with the help of computers, mainly using density-functional theory. Most of his recent work is in the field of ferroelectrics and multiferroics, both in the development of new methodology and in its application to these materials of technological interest.

ATOMISTIC SIMULATION OF FERROELECTRIC
AND MULTIFERROIC PEROVSKITE OXIDES

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ABSTRACT
At the Atomistic Simulation of Materials group we use first-principles methods related to density-functional theory to understand the properties of materials, predict the behavior of materials, and design new materials. We also have experience in developing software to accomplish these goals, in collaboration with projects such as Siesta or Quantum Espresso. Part of our efforts focus on ferroelectric and multiferroic materials, where we investigate how variables such as epitaxial strain can be used to control structural, electrical, and magnetic properties of oxides. The rest of our research efforts go into helping to understand the results of experiments of a variety of collaborators, in materials that range from electrostrictors to alloys to molecules deposited on surfaces. In our talk we will do a general review of our latest results related to those topics.

BIOGRAPHY
Dr. Oswaldo Diéguez received his PhD from University of Santiago de Compostela, Spain. After postdoctoral stays at Cambridge, Rutgers, and MIT he joined the Institute of Materials Science of Barcelona as a staff researcher. He moved to the Department of Materials Science and Engineering of Tel Aviv University in 2013, where he is a senior lecturer (assistant professor). His research involves studying the properties of materials by modelling the behavior of their electrons and nuclei with the help of computers, mainly using density-functional theory. Most of his recent work is in the field of ferroelectrics and multiferroics, both in the development of new methodology and in its application to these materials of technological interest.
SELECTIVE COUPLING OF OPTICAL MODES AND MATTER

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ABSTRACT
Controlling light-matter interaction across the energy and momentum space presents a powerful tool in many fields, such as optical sensing and energy harvesting. We present our work on optical antenna that play the interface role between the given material optical properties, and the desired ones. In particular, we show the impact in two examples: photon sensing and thermophotovoltaics. We also present a low-cost and high-throughput nanofabrication method to realize metasurfaces that have selective absorption/emission. This method can be used to generate arbitrary periodic patterns with sub-80 nm feature sizes. As examples of practical applications, we experimentally demonstrate structures with single and double spectral absorption/emission features, and in close agreement with numerical simulation. Selective infrared absorbers/emitters are critical elements in realizing efficient thermophotovoltaic cells and high-performance optical biosensors.

BIOGRAPHY
Hooman Mohseni is a professor of Electrical Engineering and Computer Sciences at Northwestern University. He is the recipient of many research and teaching award including NSF CAREER Award, DARPA Young Faculty Award, and Northwestern Faculty Honor Roll. Mohseni has served at the editorial boards of several journal including IEEE Photonics, IEEE Selected Topics in Quantum Electronics, Optics Letter, and Frontiers in Material. He has published over 120 peer-reviewed articles in major journals including Nature, Nano Letters, and ACS Nano. He holds 14 issued US and International patents. He is a Fellow of SPIE and OSA.

ELECTROCHEMICALLY DEPOSITED CALCIUM PHOSPHATE COATINGS FOR DENTAL AND ORTHOPEDIC IMPLANTS – FROM FUNDAMENTAL STUDIES TO THE CLINICS

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ABSTRACT
In recent years, interest has evolved in electrochemically-induced deposition of hydroxyapatite (HAp) and other calcium phosphates as an alternative to the traditional plasma-sprayed process for coating of orthopedic and dental implants. Here, coatings were deposited on commercially pure Ti and Ti-6Al-4V samples by cathodic polarization. The reaction kinetics was found to be controlled by charge transfer at the interface rather than by mass transport. Two growth modes were observed: instantaneous nucleation and 2D growth, followed by progressive nucleation and 3D growth. As in the human body, HAp formed via transformation of a precursor phase (octacalcium phosphate). The effects of mechanical and chemical surface pre-treatments on the adhesion strength, surface morphology, wettability, and interactions with bone-forming cells and bacteria were also studied. Animal studies were used to quantify osseointegration and evaluate the level of cracking compared to commercial plasma sprayed coatings. The importance of coating solubility in vivo will be discussed. The coatings developed exhibit clear advantages and are currently being scaled-up in industry.

BIOGRAPHY
Professor Noam Eliaz is the founding Head of the Department of Materials Science and Engineering at Tel Aviv University (TAU). He received his B.Sc. and Ph.D. (direct track) in Materials Engineering as well as M.B.A., all cum laude from Ben-Gurion University. He served for three years in the Department of Materials and Failure Analysis of the Israel Air Force. He has published over 350 research publications, including three edited books, and is Editor-in-Chief of the journal Corrosion Reviews. To date, Prof. Eliaz and his colleagues have raised over $3.2 million for research and equipment. He has served as the founding Head of the Materials and Nanotechnologies graduate program at TAU, Chairman of the 14th Israel Materials Engineering Conference, and Chairman of Central Committee for Chemistry Standards at the Standards Institution of Israel. He has garnered numerous awards, including the Fulbright and Rothschild postdoctoral scholarships (1999-2001), T.P. Hoar Award for the best paper published in Corrosion Science (2001), JSPS fellowship (Japan, 2005-7), NACE International’s H. H. Uhlig Award (2010), Fellow Award (2012), and Technical Achievements Award (2014), and Northwestern University’s Eshbach scholarship (2013). In 2015 he was elected to the Israel Young Academy. Noam is an 8th generation Israeli. He is married to Billie and is the proud father of Ofri, Shahaf, and Shalev.
CHEMICAL IMAGING OF INTERFACES AND INTERPHASES IN TOOTH BIOMINERALS

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ABSTRACT

Tooth biominerals are among the hardest biological materials. Optimized to withstand the forces of mastication, they are hierarchically structured, organic/inorganic nanocomposite materials. For example, the radular teeth of the chiton are capped with a composite made from magnetite (Fe3O4) and a nanofibrous chitin scaffold. These teeth are sufficiently hard that the chiton can abrade rocks during feeding. Human tooth enamel is composed of hydroxyapatite nanowires, thousands of which are bundled into rods that are organized in a three-dimensional weave; this provides great fracture resistance and a much enhanced fatigue life. It has long been known that the susceptibility of enamel to caries, i.e. acid corrosion, is greatly dependent on the presence of magnesium, carbonate, and fluoride ions. However, imaging the distribution of these impurities in enamel or the organic/inorganic interface in the chiton tooth has remained challenging.

I will discuss how UV-laser pulsed atom probe tomography (APT), in combination with correlative imaging and spectroscopy techniques, has given us remarkable new insights into the chemistry of organic/inorganic interfaces, grain boundaries, and amorphous intergranular phases that are integral to the mechanical properties of teeth and their resistance to corrosion.1-5 I anticipate that the capabilities and expertise we developed is relevant also for organic/inorganic materials in the fields of biomaterials, energy materials, and electronic materials and will discuss some of our forays into these areas.

BIOGRAPHY

Derk Joester is originally from Munich (Bavaria, Germany) and studied Chemistry in Tübingen. He travelled to the US on a Fulbright Scholarship to study Chemistry and Biochemistry, and then went on to get his Diploma in Organic Chemistry at ETH Zurich, Switzerland, in 1998. He received his Ph.D. for work carried out in organic, supra-molecular chemistry with Prof. François Diederich at ETH Zurich in 2003, and in the same year became a Postdoctoral Fellow at Weizmann Institute of Science in the lab of Prof. Lia Addadi in the Department of Structural Biology. From 2005-2007 he continued his research at the Weizmann Institute as a Minerva Fellow. In September 2007 he accepted a position at the Materials Science and Engineering Department at Northwestern University, Evanston, Illinois. In 2013, he was promoted to Associate Professor. His research interests include biological mechanisms of crystal growth, the role of organic/inorganic interfaces and confinement in phase transformations, metastable precursor phases, and the structure and properties biominal-organic composites with hierarchical architectures.

RECONFIGURABLE METAMATERIALS AND PHOTONIC CRYSTALS

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ABSTRACT

Photonic crystals, metamaterials and metasurfaces are emerging as powerful platform for both fundamental research as well as for a wide variety of applications such as power harvesting, biosensing and telecommunications. One of the key capabilities, still missing, is ability to dynamically reconfigure and tune the optical properties of such photonic structures.

We present our recent work of fully reconfigurable photonic crustal and metamaterials using two approaches — holographic optical tweezers and the use of phase changing materials. As specific examples, we demonstrate experimentally an optically controlled dynamic photonic bandgap material consisting of colloidal particles assembled, using Holographic Optical Tweezers, into periodic structures located between prepositioned optical fibers. We also show a new paradigm for realizing a tunable optical phased array consisting of Au slot nanoantennas over a VO2. Utilizing the phase changing properties of VO2, an incident beam can be steered up to 22° from the normal.

BIOGRAPHY

Jacob "Koby" Scheuer received the B.Sc. degree (summa cum laude) in electrical engineering and in physics, and the Ph.D. degree in electrical engineering from the Technion-Israel Institute of Technology, Haifa, Israel, in 1993 and 2001, respectively. He was a Chief Designer with Lambda crossing-an optical component startup specializing in microring resonators for two years. Then, he joined the Center for the Physics of Information and the Department of Applied Physics, the California Institute of Technology, Pasadena, as a Research Associate. Currently, he is an associate professor with the School of Electrical Engineering, Tel Aviv University, Ramat-Aviv, Tel Aviv, Israel. His main fields of research involve plasmonics, nano-antennas, micro and nano-sensors and telecommunications. Prof. Scheuer is the author or co-author of more than 100 scientific paper in peer-review journal, 4 book chapters, more than 80 papers in conference proceeding, and 10 patent applications. He is a member of the OSA a senior member of the IEEE and a fellow of the SPIE.
ROLE OF STRONG PLASMON-SENSITIZER COUPLING IN SOLAR CELLS

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ABSTRACT
Alternative energy directions offer a variety of interesting questions to scientific inquiry in addition to their technological importance. In particular, recent experiments have shown that the efficiency of photoinduced electron transfer from sensitizers (molecules or quantum dots) to semiconductors can be enhanced by coupling the sensitizers to plasmon resonances in metal nanoparticles, introducing the questions what is the enhancement mechanism and how could it be optimized. Here, we use a model-Hamiltonian approach to first illustrate the role of direct sensitizer-plasmon coupling, beyond the plasmonic field enhancement in the sensitizer’s vicinity. We next show that there is an optimal coupling between the sensitizer and the plasmons that maximizes the electron-transfer efficiency. This optimum results from the competition between electron transfer, plasmon relaxation, and plasmon decoherence. For coupling values that exceed the optimal value, the dynamics of electron transfer from the sensitizer to the semiconductor is significantly modified due to the sensitizer-plasmon coupling. Finally, we introduce a genetic algorithm to search for the structural parameters of the plasmonic construct that would maximize the electron transfer efficiency.

BIOGRAPHY
Tamar Seideman is a Dow Chemical Company Professor in Chemistry and a Professor of Physics at Northwestern University. She received a B.Sc. degree (summa cum laude) in 1982 from the Tel Aviv University, and a Ph.D. (summa cum laude) in 1990 from the Weizmann Institute of Science. She is a member of the National Academy of Science of Germany, a Fellow of the American Physical Society and a Guggenheim Fellow. Her research was recognized by several international awards including a Watson Award (2015-2018), a Mildred Dresselhaus Award for Senior Scientists (2013), a Sackler Award (2011), a Weston Award (2007-2008), an Emerson Award (1996-1997), a Wegner Award (1996), a Briner award, a J.F. Kennedy award, a Fulbright Award, a Chaim-Weizmann Fellowship, the Knesset of Israel Award Prize, a Galileo Distinguished Lecturer Award, and a Windsor Distinguished Lecturer Award. She is the author of 247 refereed publications. Among Seideman’s research interests are quantum transport, current-driven nanochemistry and molecular machines; ultrafast nanoplasmics and information guidance in the nanoscale; approaches to solar energy conversion; coherent control and coherence spectrosopies in closed and open systems; attosecond science and the interaction of matter with intense laser fields; photomanipulation of external and internal molecular modes; and mathematical method development.

MATERIALS FOR BIORESORBABLE ELECTRONICS
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ABSTRACT
A remarkable feature of modern integrated circuit technology is its ability to operate in a stable fashion, with almost perfect reliability and without physical or chemical change. Recently developed classes of electronic materials create an opportunity to engineer the opposite outcome, in the form of devices that can dissolve completely in water to yield completely benign end products. The enabled applications include zero-impact environmental monitors, ‘green’ consumer electronics and bioreosrable biomedical implants — none of which is possible with technologies that exist today. This presentation describes foundational concepts in chemistry, materials science and assembly processes for bioreosrable electronics, in 1D, 2D and 3D architectures, the latter enabled by approaches that draw inspiration from the ancient arts of kirigami and origami. Wireless sensors of intracranial temperature, pressure and electrophysiology designed for use in treatment of traumatic brain injury provide application examples.

BIOGRAPHY
Professor John A. Rogers obtained BA and BS degrees in chemistry and in physics from the University of Texas, Austin, in 1989. From MIT, he received SM degrees in physics and in chemistry in 1992 and the PhD degree in physical chemistry in 1995. From 1995 to 1997, Rogers was a Junior Fellow in the Harvard University Society of Fellows. He joined Bell Laboratories as a Member of Technical Staff in the Condensed Matter Physics Research Department in 1997, and served as Director of this department from the end of 2000 to 2002. He currently holds the Swanlund Chair at the University of Illinois at Urbana/Champaign. He will become the Louis Simpson and Kimberly Querrey Professor of Materials Science and Engineering, Biomedical Engineering and Medicine at Northwestern University in the Fall of 2016. His research has been recognized by many awards including a MacArthur Fellowship (2009), the Lemelson-MIT Prize (2011), the MRS Mid-Career Researcher Award (2013) and the ETH Zurich Chemical Engineering Medal (2015). He is a member of the National Academy of Engineering, the National Academy of Sciences, the National Academy of Inventors and the American Academy of Arts and Sciences.
BIO-INSPIRED PHOTOVOLTAICS

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ABSTRACT
Proteins form the very basis of life. They regulate a variety of activities in all known organisms, from replication of the genetic code to transporting oxygen, and are responsible for regulating the cellular machinery and determining the phenotype of an organism.

With this respect, it is intriguing to explore the photovoltaic properties of light harvesting proteins. The photosynthetic protein, Photosystem I (PSI) member of this family exhibits extraordinary properties in its natural environment. During the last few years, we explored its photo-voltaic and plasmonic properties while embedded in solid-state devices. In this talk, the results of our studies will be introduced.


BIOGRAPHY
Assoc. Prof. Shachar Richter is a faculty member at the newly-established Department of Materials Science and Engineering at Tel Aviv University. He earned his BSc in Chemistry from Tel Aviv University and his MSc and PhD (Chemical Physics and Materials Science) from The Weizmann Institute of Science, Rehovot. During 1998-2001 Dr. Richter was a postdoctoral scholar and a staff member (MTS) at Bell-Laboratories (NJ, USA). In 2001 he joined Tel Aviv University where he established the Nano-Electronics lab at the Center for Nanoscience and Nanotechnology, as a core member of the Center. During 2003-2013 he was a faculty member at the School of Chemistry. Prof. Richter is the author of more than 55 peer reviewed publications and patents. His current research interests are molecular- and bio-electronics, bio-nanocomposites and novel patterning technologies. His group consists of ~10 members, including graduate students, postdocs and engineers with diverse backgrounds in chemistry, biology, physics and engineering.

CARDIAC TISSUE ENGINEERING: FROM MATRIX DESIGN TO THE ENGINEERING OF CYBORG TISSUES

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ABSTRACT
The heart is a non-regenerating organ. Consequently, the loss of cardiac cells and formation of scar tissue after extensive myocardial infarction frequently leads to congestive heart failure. Given the scarcity of cardiac donors, a potential approach to treat the infarcted heart is to repopulate the ‘dead zone’ with cells capable of spontaneous contraction. Cellular therapy evolved to introduce cells into diseased areas and regain function. However, two main drawbacks of this approach are the lack of control of cell accumulation site after injection, and cell death before forming cell-cell or cell-matrix interactions. These shortfalls motivated the development of the tissue engineering concept, where 3-dimensional (3D) biomaterials serve as extracellular matrix-like scaffolds to the cells, enabling the cells to assemble into effective tissue substitutes, that may restore tissue or organ function. After transplantation the scaffolds either degrade or metabolize, eventually leaving a vital tissue instead of the defected tissue. In this talk I will describe cutting-edge technologies for engineering functional cardiac tissues, focusing on the design of new biomaterials, mimicking the natural microenvironment of the heart, or releasing biofactors to promote stem cell recruitment and cardioprotection. I will also describe the concept of 3D bioprinting of tissues and organs, and the use of inorganic nanostructures and devices for monitoring, actuating and regulation of tissue performances in vitro and in vivo.

BIOGRAPHY
Dr. Dvir obtained a B.Sc. (2003) and a Ph.D (2008) degrees in Biotechnology Engineering from Ben-Gurion University of the Negev in Israel. His Ph.D research was supervised by Prof. Smadar Cohen and focused on cardiac tissue engineering and regeneration. Dr. Dvir continued his postdoctoral studies in the laboratory of Prof. Robert Langer in the Department of Chemical Engineering at MIT. His postdoc research focused on nanotechnological strategies for engineering complex tissues. On October 2011 Dr. Dvir was recruited by the Department of Biotechnology and the center for Nanotechnology at Tel Aviv University to establish the Laboratory for Tissue Engineering and Regenerative Medicine. On 2013, Dr. Dvir has also joined the newly established Department of Materials Science and Engineering at Tel Aviv. His current research interests include micro and nanoscale technologies and biomaterials for regenerating diseased or injured organs such as the heart, brain and spinal cord.
EXPANDING THE 3D PRINTABLE BIOMATERIAL PALETTE: NEW APPROACHES TO MATERIAL DESIGN AND DEVELOPMENT

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ABSTRACT
3D printing shows significant promise in the biomedical field for enabling the fabrication of more complex tissue and organ mimics, as well as implants that can be tailored for a patient’s specific anatomy and biological need. However, the lack of 3D printable biomaterials that can present optimal biological, chemical, and physical properties for regenerative engineering is a significant inhibitor to the advancement and growth of 3D printing in this area. One of the major research efforts in my group is expanding the current biomaterial toolbox for 3D printing in order to provide a wider variety of tailorable and cell-compatible materials for optimizing the functionality of the resulting 3D printed constructs. In this talk I will present new biomaterial inks we have developed, their unique and advantageous properties, and their promise in a variety of regenerative medicine applications. With further advancements in 3D printable biomaterial ink technologies we may be able to provide more effective platforms for drug testing and studying tissue morphogenesis, as well as begin to develop alternative strategies to help solve transplant needs.

BIOGRAPHY
Prof. Ramille Shah earned her B.S. in Materials Science and Engineering (MSE) at Northwestern University and her Ph.D. in MSE with a specialty in Biomaterials from Massachusetts Institute of Technology with a research focus on gene-supplemented collagen scaffolds for cartilage tissue engineering. In 2006, she returned to Northwestern as a postdoctoral fellow at the Simpson Querrey Institute for BioNanotechnology focusing on self-assembling nanomaterials for regenerative medicine. In September 2009, she started her tenure-track faculty position with a joint appointment in the Departments of MSE and Surgery at Northwestern. Since then, she has become a leader in the area of functional materials development for 3D printing. Her research focuses on understanding how 3D material ink processes and properties influence printability, as well as how they affect the properties and functionality of the resulting 3D printed constructs. Towards this effort, her group engineers specialty 3D inks and optimizes printing processes to create materials and devices for both biological (e.g. musculoskeletal and complex organ tissue engineering) and non-biological (e.g. energy and advanced structural) applications. Her most recent awards include being chosen as one of Chicago Crain’s Business Magazine’s 40 Under 40 and receiving the Clarence Ver Steeg Graduate Faculty Award.

METALLIC SCAFFOLDS BY REDUCTION OF 3D-PRINTED OXIDE INKS

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ABSTRACT
We present a novel approach to metal additive manufacturing that does not utilize metallic powders, directed energy beams, or powders beds, as in traditional directed electron or laser beam methods. Rather, inks consisting of metal oxide particles, are 3D-printed via direct ink writing (DIW) into self-supporting, cellular structures which are transformed into metallic counterparts through debinding, thermochemical reduction and sintering in hydrogen. The inks—comprised of submicron- to micron metal oxide powder(s), an elastomeric binder, and solvents—can be rapidly 3D-printed to create centimeter-scale cellular structures comprised of sub-millimeter struts (200-600 μm in diameter) arranged in layers, from a single layer (0.2 mm high sheet) to hundreds of layers (14 cm high scaffold). Because the binder is an elastomer, the printed scaffold can be bent, stretched, cut or solvent-fused before hydrogen reduction and sintering which results in high shrinkage but neither cracking nor distortion. We demonstrate that a wide variety of cellular metals (e.g., Fe, Cu, Ni, Co, W) and alloys can be fabricated from inexpensive metal oxide powders using simple equipment and that metal powders can also be used as an alternative to oxide powders.

BIOGRAPHY
Dunand holds a BS/MS from ETH (Zurich) and a Ph.D. from the Massachusetts Institute of Technology where he was on the faculty until 1997, when he joined Northwestern University (NU) where he is now the James and Margie Krebs Professor of Materials Science and Engineering. In 2008, he was the founding co-director of the Initiative for Sustainability and Energy at Northwestern (ISEN) and he held this position until early 2015. Dunand holds over ten patents and has published over 320 journal articles. His research focuses on processing, structure and mechanical properties of metallic alloys, composites and foams. Dunand is a fellow of ASM International and of TMS. He has received several awards, including the 2012 Materials Science and Engineering A Journal Prize, the 2009 Distinguished Scientist/Engineering Award Structural Materials Division of TMS and twice a departmental Teacher of the Year Award at NU. Dunand is co-Founder and co-Chief Scientist, together with Prof. David Seidman, of NanoAl, LLC, a start-up company developing novel high-temperature alloys at the intersection of nano- and green tech.
Dr. Rosen is currently a senior lecturer in the Department of Materials Science and Engineering at Tel Aviv University. He received his BS from the University of Delaware and his MS and PhD from the University of Illinois at Urbana-Champaign, all in Chemical Engineering. His doctoral work focused on the low overpotential electrochemical conversion of CO₂ and H₂O to synthesis gas utilizing ionic liquid electrolytes. This work was published in 2011 in Science, and in 2013 in Nature Communications. Dr. Rosen has co-authored over 10 patents describing the use of this novel co-catalyst system. This research has also brought about the creation of a start-up company Dioxide Communications on the low overpotential electrochemical conversion of CO₂ to H₂O to synthesis gas utilizing ionic liquid electrolytes. This work was published in 2011 in Science, and in 2013 in Nature Communications. Dr. Rosen has co-authored over 10 patents describing the use of this novel co-catalyst system. His current research investigates electrocrystallization, nanomaterial synthesis, and electrolysis for GTL and fuel cell technology.

Here, we discuss how depletion effects within the parent Perovskite and the pathway taken during solid-phase crystallization influences the final material enabling sustainable and intelligent catalyst design.

The exploitation and control of structure in methane reforming catalysts remains a significant challenge to chemists and engineers worldwide. Currently, methane conversion catalysts are limited by their ability to resist surface carbon accumulation, sintering, and unwanted oxidation. These mechanisms are detrimental to catalyst lifetime and have prevented processes such as methane dry reforming from large scale industrialization. All of these deactivation mechanisms are highly influenced by the strength of the interaction between the active catalyst and its support, as well as the size and shape of the active catalyst phase. Solid-phase crystallization of well-ordered materials has been proposed to be an effective single-step method for forming catalysts with strong metal-support interactions. So far, investigation of this method has largely focused on bulk and supported Perovskites (ABO₃) as the parent phase and the influence of non-stoichiometric formulations on the ability to exsolve metal (B-atom) crystals. These studies revealed that A-site deficiencies in conjunction with oxygen vacancies beyond a limiting concentration (\(n_{\text{lim}}\)) destabilize the Perovskite structure sufficiently such that the B-atom would exsolve in order to maintain the original stoichiometry. This work investigates how shape-control of the parent LaNiO₃ Perovskite nanoparticle can be exploited to imbue a favorable spatial distribution of exsolved Ni crystals, a strong catalyst-support interaction, and provide for long-term coke-free catalytic methane oxidation. Here, we discuss how depletion effects within the parent Perovskite and the pathway taken during crystallization influences the final material enabling sustainable and intelligent catalyst design.

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**ABSTRACT**

**COMPENSATED SEMICONDUCTORS — CALCULATIONS AND EXPERIMENTAL RESULTS**

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**ABSTRACT**

The semiconductors can be roughly divided into intrinsic (or near-intrinsic), extrinsic, and compensated. Most microelectronic applications require extrinsic semiconductors for junction formation; however some niche applications require high resistivity semiconductors and/or materials with low fixed charge density. There are few semiconductors that can be grown near-intrinsic (e.g., high-purity germanium, float-zone silicon), however, their resistivity is limited by the relatively small band-gaps. Most wide bandgap semiconductors (CdZnTe, diamond, ZnS, HgI₂, etc.) tend to grow with large defect concentrations, and the high resistivity is achieved through intentional or unintentional deep-level compensation.

Many canonical concepts in semiconductors originate in extrinsic case approximations (e.g. “depletion approximation” in junctions), and they do not apply to the compensated case. Thus, the study of such semiconductor devices require detailed computer aided calculations.

The presentation will focus on modeling of the compensation mechanisms and experimental studies of compensated CdZnTe and diamond radiation detectors. The experimental part will include permittivity characterization of various DVD-diamond samples, Deep Level Transient Spectroscopy results, Current activation energy characterization, and employing TDF (time of flight) technique.

**BIOGRAPHY**

Born in former USSR, and immigrated to Israel in 1976. Graduated B.Sc., M.Sc., and D.Sc. at the Israeli Institute of Technology (Technion). Following D.Sc. graduation and short-term research position at the Technion, received 2-year Fellowship at CERN (Switzerland). In the end of 1999 joined the Tel Aviv University as a senior lecturer. Currently acting as the head of the Israeli team at RD-50 collaboration at CERN. Actively participated organization and technical committees of various conferences (e.g., EMRS, SPIE). Senior member of IEEE, SPIE and OePG.

Dr. Rosen has co-authored over 10 patents describing the use of this novel co-catalyst system. This research has also brought about the creation of a start-up company Dioxide Communications. His current research investigates electrocrystallization, nanomaterial synthesis, and electrolysis for GTL and fuel cell technology.

**BIOGRAPHY**

Dr. Rosen is currently a senior lecturer in the Department of Materials Science and Engineering at Tel Aviv University. He received his BS from the University of Delaware and his MS and PhD from the University of Illinois at Urbana-Champaign, all in Chemical Engineering. His doctoral work focused on the low overpotential electrochemical conversion of CO₂ and H₂O to synthesis gas utilizing ionic liquid electrolytes. This work was published in 2011 in Science, and in 2013 in Nature Communications. Dr. Rosen has co-authored over 10 patents describing the use of this novel co-catalyst system. This research has also brought about the creation of a start-up company Dioxide Communications. His current research investigates electrocrystallization, nanomaterial synthesis, and electrolysis for GTL and fuel cell technology.

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Tobin Marks is Ipatieff Professor of Catalytic Chemistry, Professor of Materials Science and Engineering, and Professor of Applied Physics at Northwestern University. He received a chemistry B.S. from the University of Maryland and an inorganic chemistry Ph.D. from MIT. His research interests include organometallic chemistry; catalysis; vibra-tional spectroscopy; metallo¬protein active sites; car¬cinostatic metal complexes; solid state chemistry; nonlinear optical materials; polymer chemistry; laser-induced chemistry; molecular electro-optics; metal-organic chemical vapor deposition; polymerization catalysis; printed electronics; solar energy; and transparent conductors. Combining these materials sets to fabricate a variety of high-performance thin-film transistor-based circuits and heterojunctions. The relevance of these advances to unconventional photovoltaic materials. This presentation emphasizes the vibrant symbiosis between materials synthesis, computational modeling and simulation, materials characterization, and device fabrication and evaluation.

ABSTRACT
This lecture focuses on the challenging design, realization, characterization, understanding, and implementation of new materials for creating unconventional electronic circuitry. Fabrication methodologies to achieve these goals include high-throughput, large-area, high-resolution printing techniques. Materials design topics to be discussed include: 1. Rationally designed high-mobility p- and n-type organic semiconductors for printed organic CMOS, 2. Self-assembled and printable high-k nanodielectrics enabling ultra-large capacitance, low leakage, high breakdown fields, minimal trapped interfacial charge, and device radiation hardness, 3. Polycrystalline and amorphous oxide semiconductors for transparent and mechanically flexible electronics, 4. Combining these materials sets to fabricate a variety of high-performance thin-film transistor-based circuits and heterojunctions, 5. The relevance of these advances to unconventional photovoltaic materials. This presentation emphasizes the vibrant symbiosis between materials synthesis, computational modeling and simulation, materials characterization, and device fabrication and evaluation.

BIOGRAPHY
Tobin Marks is Ipatieff Professor of Catalytic Chemistry, Professor of Materials Science and Engineering, and Professor of Applied Physics at Northwestern University. He received a chemistry B.S. from the University of Maryland and an inorganic chemistry Ph.D. from MIT. His research interests include organometallic chemistry; catalysis; vibra-tional spectroscopy; metallo¬protein active sites; carcinostatic metal complexes; solid state chemistry; nonlinear optical materials; polymer chemistry; laser-induced chemistry; molecular electro-optics; metal-organic chemical vapor deposition; polymerization catalysis; printed electronics; solar energy; and transparent conductors. His recognitions include six ACS National Awards, the 2006 U.S. National Medal of Science, the 2008 Prince de Asturias Prize, the 2009 the MRS Von Hippel Award, the 2011 Dreyfus Prize in the Chemical Sciences, the 2013 U.S. National Academy of Sciences Award in the Chemical Sciences, and the 2017 ACS Priestley Medal. He is an elected member of the U.S., German, and Indian National Academies of Sciences, of the U.S. National Academy of Engineering, the U.S. National Academy of Inventors, a Fellow of the Royal Society of Chemistry, and of the American Academy of Arts and Sciences. He has received approximately 185 other awards, medals, prizes, and lectureships, has published 1255 peer-reviewed articles, and holds 236 issued U.S. patents.
**3D TOMOGRAPHY OF FUEL CELL AND BATTERY ELECTRODES: ELECTROCHEMICAL PERFORMANCE AND LONG-TERM DURABILITY**

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**ABSTRACT**

Fuel cell and battery electrodes have complex multi-phase morphologies. Quantitative analysis of this electrode microstructure is a key element in connecting materials processing and electrochemical performance, as well as understanding degradation mechanisms. This paper will describe three-dimensional (3D) electrode tomography measurements and results from the use of this data — including in 3D simulation models of electrochemical processes and correlation of measured microstructural evolution with degradation of electrochemical properties. 3D measurements and electrochemical simulations of solid oxide fuel cell (SOFC) electrodes including Ni-Y-stabilized Zirconia (Ni-YSZ), (La,Sr)MnO3-YSZ, and (La,Sr)(Fe,Co)O3; as well as of Li-ion battery positive electrodes (e.g., LiFePO4 and LiCoO2) will be discussed. Experimental and simulation results on the structural evolution of Ni-YSZ electrodes, and how the changing microstructure impacts electrochemical performance, will be described.

**BIOGRAPHY**

Scott A. Barnett is a Professor in the Materials Science and Engineering department at Northwestern University. After receiving his Ph.D. in Metallurgy from the University of Illinois at Urbana-Champaign in 1982, he held postdoctoral appointments at the University of Illinois and Linköping University (Sweden), took his present position at Northwestern in 1986. His research utilizes ceramic materials processing utilizing physical vapor and colloidal deposition methods. Research interests range from ceramic thin films to Li-ion battery (LIB) electrodes to solid oxide fuel cells (SOFCs). Three-dimensional tomographic microstructural measurements of SOFC and LIB electrodes are used to understand electrochemical performance and long-term degradation mechanisms. Novel materials and structures for low-temperature SOFC operation are being developed. Reversible SOFC operation is being investigated as a new means for grid-scale energy storage.

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**2D MATERIALS: SYNTHESIS OF FLAT AND 3D STRUCTURES**

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**ABSTRACT**

Following the recent exciting scientific results on graphene, 2D atomic-films in general have attracted extensive interest in the scientific and technological communities due to the wide range of potential properties and thus applications these materials (and their combination) have. Another topic of high scientific and technological interest would be the rational formation of 2D materials-based heterostructures and the implementation of 2D materials into 3D structures for a wide variety of applications, such as composite materials, thermal management, catalysis, electronic and opto-electronic devices, etc.

In this talk I will review recent advances in the growth and characterization of single- and few-layer transition metal dichalcogenides (TMDs). Then I will describe our efforts to target the controlled synthesis of TMD-based heterostructures. We have achieved by the sulfurization and selenization of thin metal films pre-deposited on substrates or by the direct chemical vapor deposition using different precursors. The difference in the formation, structure and properties will be described. I will finalize by describing our efforts for the formation of multi-layer graphene-based 3D structures with tailored properties.

**BIOGRAPHY**

Dr. Ariel Ismach immigrated to Israel from Argentina. He holds a BEng in Materials Engineering from Ben Gurion University of the Negev, and an MA and PhD in Materials and Surfaces from the Faculty of Chemistry, Weizmann Institute. He was awarded a prize from the Israel Chemistry Society for his doctoral thesis on “epitaxial approaches for the self-organization of single-wall carbon nanotubes”. In 2009 he moved to Berkeley for a joint post-doctoral position at the Department of Electrical Engineering, University of California-Berkeley and the Materials Science Division of the Lawrence Berkeley Laboratory. In 2011 he joined the group of Prof. Ruoff in the department of Mechanical Engineering, at the University of Texas in Austin, where he headed a small group of Ph.D. students and postdocs studying the growth and characterization of various 2D materials. He joined the Materials Science and Engineering department at Tel Aviv University in October 2014 where he is establishing a laboratory dedicated to study the growth of 2D atomic-crystals.
NOVEL NANO-ARCHITECTURES: WATER, ENERGY & HEALTH

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ABSTRACT

The ability to engineer materials at atomic and molecular scales promises solutions to many environmental and public health challenges. Fundamental study of structure-function relationships for TiO$_2$-based nanocomposites has revealed the importance of phase boundaries in charge transfer and catalyzed reactions. This knowledge has directed the design and synthesis of novel nano-architectures of TiO$_2$-based materials for application in reactive membranes, thin-film coatings, and selective oxidation. In addition, progress has been made in applying this knowledge to the conversion of CO$_2$ to produce solar fuels. Despite the far-reaching benefits of nanotechnology, very little attention has been given to its unintended effects on public and ecological health. Recent evidence reveals that highly reactive, hybrid nanomaterials are self-assembled by the environmental processing of nanomaterial mixtures and exert greater toxicity than the parent materials. How does this emerging knowledge of nanomaterial risk influence our assessment of nanotechnology in comparison to alternative strategies to protect water resources and provide clean energy?

BIOGRAPHY

Kimberly Gray is a Professor and Chair of the Department of Civil and Environmental Engineering at Northwestern University. She has a secondary appointment in the Dept. of Chemical and Biological Engineering and is a member of the Center for Catalysis and Surface Science and the Transportation Center. She is a faculty affiliate in the Searle Center on Law, Regulation, and Economic Growth in the Pritzker School of Law. Gray received her Ph.D. from the Johns Hopkins University and was a research engineer for the Lyonnaise des Eaux in Paris, France for 2 years. Her areas of expertise are environmental catalysis and physicochemical processes in natural and engineered environmental systems with particular focus on energy and sustainability applications. She studies the synthesis, characterization and performance of photo-active materials, principally TiO$_2$-based nanocomposites for solar fuel production and water/air treatment. She investigates chemical fate in natural systems and probes the role of trophic structure in the bioaccumulation of contaminants in aquatic systems, as well as the influence of chemical and biological parameters on denitrification in wetlands. She is also studying the ecotoxicology of nanomaterials in aquatic systems. Gray is the author of over 120 scientific papers and lectures widely on energy, climate and environmental issues.

CARBON NANOTUBES NANOCOMPOSITE MORPHOLOGY TAILORING (FOR ENERGY STORAGE)

Noa Lachman
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ABSTRACT

The high electrical conduction and high surface area of carbon nanotubes (CNT) make them an ideal material for electrodes in electrochemical capacitors (a.k.a. “supercapacitors”). CNT electrodes advantage further increase when they are vertically aligned (VA-CNT), creating undistorted paths for charge transport. In this talk, ways to further enhance the VA-CNT electrodes performance by controlling VA-CNT morphology will be discussed, with emphasis on using chemical vapor deposition (CVD) to coat the high surface area of VA-CNT with nano-layer of conductive polymer (CP). The experiments show that 10nm of CP coating layer leads to an order of magnitude increase in capacitance, resulting in both higher energy density at low scan rate(140wh/kg vs. 80wh/kg for uncoated CNT) as well as increases power density (~50kw/kg vs. 30kw/kg for uncoated CNT). The techniques used to tailor and characterize said morphologies will also be discussed. The presented work was done at MIT as a postdoctoral scholar under the guidance of Prof. Wardle.

BIOGRAPHY

Dr. Noa Lachman is a new member in the department of materials science and engineering, previously a postdoctoral Associate at the department of Aeronautics and Astronautics at MIT. She received a B.S. (2003) in Chemistry and Physics from the Hebrew University in Jerusalem, Israel, and completed her Ph.D. work (2010) at the Weizmann Institute of Science, in the department of Materials and Interfaces. Her research with Prof. Wardle at MIT focused on tailoring and imaging of VA-CNT based composites for various application, including energy storage and multi-functional structure materials. Dr. Lachman uses experimental techniques to obtain knowledge of nano-structure effect on mechanical and functional properties of these new materials, and she aims to develop a structure-function dataset which will enable the design of new materials with improved efficiency and performance. Dr. Lachman has authored and co-authored 18 journal articles.
Upstream treatment of hospital wastewater is a relatively new approach that until now has only been examined in a limited number of studies. The research findings point on a high potential of the approach in elimination of organic micro/nano-pollutants (OM/NPs) already within the hospital premises. The main bottleneck however is the current stage of optimization of existing treatment technologies for a combined cost-efficient elimination of OM/NPs. Previous studies explored the potential of biological treatment that was significantly lower than requested treatment goals. Some new studies proposed complementary treatments after bio-treatment including MBR based on either active carbon or ozone based Advanced Oxidation Processes (AOP). This pilot study proposes, for the first time, a hybrid biological physical treatment based on a combination of membrane bioreactor (MBR) and AOP that is part of the bio-treatment and does not come as a complementary treatment. Pilot experiments were performed at Tel HaShomer hospital including patented modifications of ADP to achieve a maximal retention of OM/NP combined with a precise pore size modification of MBR membranes.
APPLICATION OF NANOSTRUCTURED SOLAR PHOTOCATALYTIC MEMBRANE REACTORS (PMRS) FOR WATER TREATMENT

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ABSTRACT
The use of semiconductors in combination with sunlight irradiation (i.e., photocatalysis) for the treatment of water and wastewater is classified as a heterogeneous advanced oxidation process (AOP). A hybrid photoreactor system combining both membrane filtration and photocatalysis can address multiple functions besides traditional physical separation as degradation of organic pollutants, inactivation of microorganisms and self-antibiofouling action. In the thin-film photocatalytic membrane reactor (PMR) hybrid configuration, the catalyst is embedded, and thus immobilized, in a membrane matrix and activated by direct illumination of the membrane. A highly efficient UV-vis-active N-doped TiO2-coated Al2O3 MF membrane based PMR was recently published by our research group. The photocatalytic activity of the PMR was determined by the degradation of the model micropollutant carbamazepine and using a solar simulator as the light source. It was found that membrane permeation provided a more effective contact between the reactants and the photocatalytically active sites by introducing, in addition to diffusion, forced transport of reactants by convection inside the pore channels owing to membrane high tortuosity. Disinfection of virus particles by PMR may prove to be challenging as the surface-particle interaction is crucial to process efficiency due to steric hindrance. Thus, the objective of this study is to examine the complex interactions between virus particles and PMR. A model will be developed to give a prediction to virus inactivation by considering virus-photocatalyst interactions while flowing in porous material (e.g., diffusion, adsorption-desorption, surface reaction).

BIOGRAPHY
Professor Hadas Mamane is a faculty member and associate professor at the Engineering School of Tel Aviv University (TAU), Israel. Dr. Mamane is the Head of the Water-Tech Laboratory. Dr. Mamane received her B.Sc. and Ph.D in 2005, in Chemical and Environmental Engineering, all cum laude from the Technion and Duke University respectively. She conducted her postdoctoral studies at TAU through a Porter fellowship. Dr. Mamane’s research focuses on novel technologies for water treatment, with expertise in ultraviolet (UV) and solar disinfection, advanced oxidation processes (AOP), and water and wastewater characterization. She has published 40 papers, including two book chapters on UV disinfection of water and waste water. Dr. Mamane has recently organized the second MidEast Conference on Ultraviolet Technologies. She is married to Dan and is the proud mother of Avigal, Imri, and Amitei.