Water Research Center
Tel Aviv University

The Water Research Center News
"Qwaterly"
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"Qwaterly" drop: In this issue, the new researcher, Dr. Innes Tzuker present her academic focuses, and we get a brief insight into the removal of iodinated contrast media by microalgal. ENJOY! *Sincerely, Qwaterly*

Environmental materials and processes: multidisciplinary research in the Zucker laboratory

Dr. Ines Zucker, a young researcher and member of the WRC-TAU, shares her experience in starting up a new research laboratory and current research topics.

My academic background includes a B.Sc. in Mechanical Engineering, a M.Sc. in Materials and Nanotechnology Engineering, and a Ph.D. focusing on Environmental Engineering. In late 2016, my family and I moved to the US, where I conducted my postdoctoral research at Yale University, which offered the knowledge and capabilities to enhance my interdisciplinary material–environmental research. Along the way, I was very lucky to be mentored by diverse inspiring researchers—including Prof. Reuven Boxman, Prof. Hadas Mamane, Prof. Dror Avisar, and Prof. Menachem Elimelech—and I am fortunate to have had their support and guidance throughout the different phases of my scientific career.

In early 2019, I was jointly appointed as a senior lecturer in the School of Mechanical Engineering and the Porter School of Environmental and Earth Sciences at TAU. Using a wide skill set that combines material science, analytical chemistry and water-treatment tools, my laboratory focuses on advanced materials and novel approaches for environmental applications, and on the environmental and health impacts of nanotechnology. In this feature, I share my research rationale and provide some examples of my laboratory's short-term research goals.

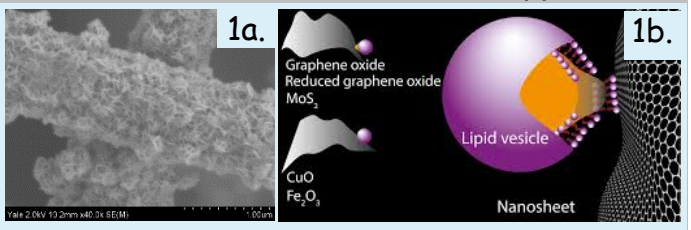


Figure 1a.: Representative scanning electron microscopy image of synthesized molybdenum disulfide-enabled fiber (MoS2@fiber); Figure 1b.: Schematic illustration of a lipid vesicle structure encapsulating a fluorescent dye and possible mechanisms of interaction with graphene oxide (right). Fluorescent dye leakage induced by two-dimensional nanomaterials was found to be material-dependent (left).

Contamination of drinking-water sources, such as rivers, lakes, and groundwater, by organic and inorganic pollutants is a major global problem in both developing and industrialized countries. In recent years, nanotechnology-based approaches have been examined as potential alternatives to decontamination methods. I find innovations in novel materials with superior decontamination properties to be the most exciting and promising development of nanotechnology, and am focusing my research on "bottom-up" design concepts for nanocomposites with complex nanostructures. We are also focused on implementing such technologies for real-world applications, for example, by evaluating the recycling and regeneration properties of our multifunctional decontamination units.

It should be noted that although engineered nanomaterials offer promise as active components in next-generation environmental technologies, they may also pose health risks through unintended exposure. Precluding negative environmental impacts of emerging nanomaterials necessitates a fundamental understanding of their interaction with cell membranes, which serve as a protective barrier against the surrounding environment. Our research aims to identify the relations between toxicity and nanomaterial surface chemistry, lipid bilayer structures, and environmental conditions, to ultimately develop a practical sensing tool for nanomaterial toxicity assessment.

To recap, our group is involved in the design, preparation, characterization, and testing of materials and processes for environmental applications. We are also focused on quantifying the risk of nanomaterials to the environment and identifying future areas of research necessary to realize safe deployment of promising nanomaterial applications. In my laboratory, I hope to generate a creative environment for scientists from different disciplines, to grow generations of high-level researchers, and to simply enjoy what we are doing!

The Zucker laboratory at TAU

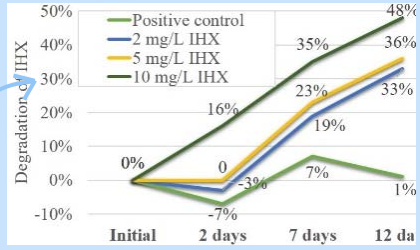
Projects and collaborations:

Two major collaborations with marine biologists have been recently initiated by the hydrochemistry laboratory. A collaboration with Prof. Noa Shenkar from the Zoology Department, Tel Aviv University, was established 2 years ago. This first successful collaboration, aimed to detect the presence of plastic additives in marine organisms, was completed a year ago, and two papers were published from that study. The current collaboration focuses on detecting pharmaceutical residues in the body tissues of ascidians—marine invertebrates—along the Israeli coastline.

An additional collaboration established a year ago with Prof. Oren Levi from the Life Sciences Faculty, Bar-Ilan University. The goal of that work is to study the effect of artificial light, as a pollution source, on corals, by analyzing quantities of sex hormones released from the coral during its reproduction period and after exposure to different light regimes. A paper has been recently published: Characterizing the physiological consequences of Artificial Light at Night (ALAN) on corals from the Red Sea.

Focus on iodinated Contrast media removal by microalgal biodegradation:

Microalgal applications are becoming more and more diverse, ranging from wastewater treatment to the production of biofuels and plastics.



In research at the WRC-TAU, we are studying removal of the iodinated contrast media Iohexol by Chlorella sp. microalgae. Chlorella removed 40–50% of the Iohexol from the medium, 23–30% of which was biodegradable. Many of these biodegradation products are the same as those obtained in the ozonation process. This could be a promising method to remove iodinated contrast media from drinking water and wastewater.

Conferences:

August 2019 – A microbiology and wastewater-treatment seminar was held for 3 days for WRC-TAU students and researchers by Dr. Ofir Menashe from Kinneret College. The seminar covered many aspects of microbiology in wastewater-treatment processes: fundamentals, new approaches and innovations.

July 2019 - A Water Sensitive Cities Conference was held at TAU, organized by the WRC and the Center for Water Sensitive Cities in Israel on 18 July 2019.

New publications:

I. Ayalon, L. F. de Barros Marangoni, J. I. Cohen, D. Avisar and O. Levy (2019) Characterizing the physiological consequences of Artificial Light at Night (ALAN) on corals from the Red Sea. Global Change Biology. Submitted.

D. Avisar and G. Ronen-Eliraz (2019) Agricultural irrigation with effluent – what should we be worried about? Journal of Basic & Applied Sciences. In press.

Y. Gerchman, V. Cohen-Yaniv, Y. Betzalel, S. Yagur-Kroll, S. Belkin and H. Mamane (2019) The involvement of superoxide radicals in medium pressure UV derived inactivation. Water Research, 161, 119-125.

Y. Betzalel, Y. Gerchman, V. Cohen-Yaniv and H. Mamane (2019) Novel and rapid measurement of UV-LED uniformity and dose-response curves using multiwell plates. Submitted.

Y. Rosen, H. Mamane and Y. Gerchman (2019) Short ozonation of lignocellulosic waste as energetically favorable pretreatment. Bioenergy Research, 12, 292.

R. Peretz, E. Sterenzon, Y. Gerchman, V. KumarVadivel, T. Luxbacher and H. Mamane (2019) Nanocellulose production from recycled paper mill sludge using ozonation pretreatment followed by recyclable maleic acid hydrolysis. Carbohydrate Polymers, 216, 343-351.

P. K. Akao, V. Cohen-Yaniv, R. Peretz, Y. Kinel-Tahan, Y. Yehoshua, H. Mamane (2019) Effect of ozonation on Spirulina platensis filaments by dynamic imaging particle analysis. Biomass and Bioenergy, 127, 105247.

T. Peng, J. Pulpytel, I. Horovitz, A. K. Jaiswal, D. Avisar, H. Mamane, J. A. Lalman and F. Arefi-Khonsari (2019) One-step deposition of nano-Ag-TiO2 coatings by atmospheric pressure plasma jet for water treatment: Application to trace pharmaceutical removal using solar photocatalysis. Journal of Plasma Processes and Polymers. DOI: 10.1002/ppap.201800213

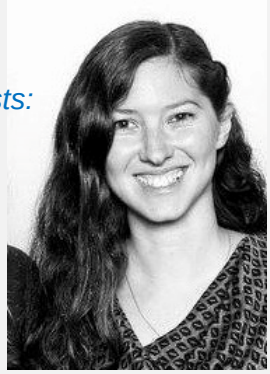
A. Dandapat, I. Horovitz, H. Gnayem, Y. Sasson, D. Avisar, T. Luxbacher and H. Mamane (2018) Solar photocatalytic degradation of trace organic pollutants in water by bi(0) doped bismuth oxyhalides thin films. ACS Omega 3(9), 10858-10865.

I. Horovitz, V. Gitis, D. Avisar and H. Mamane (2018) Ceramic-based photocatalytic membrane reactors for water treatment – where to next? Reviews in Chemical Engineering. DOI: https://doi.org/10.1515/revce-2018-0036

F. Nakonechny, D. Avisar, Z. Ludmer, N. Brauner and A. Ullmann (2019) Application of partially miscible solvent system for an efficient extraction of organic pollutants from contaminated sludge. Water, Air & Soil Pollution, 230(4), 86.

The Moshe Mirilashvili Institute:

The institute supports international collaborations and outstanding scientists:



Adi Zilberman - Adi has a Bachelor's degree in Biology and Environmental Science. She is now working on her Master's degree with Prof. Dror Avisar and Prof. Hadas Mamane, studying the removal of pharmaceuticals from hospital wastewater. She is managing the pilot system at Tel Hashomer hospital which combines a membrane bioreactor treatment facility followed by an ozone system, to increase effluent biodegradability.