Seminar

Department of Materials Engineering

Thursday, November 13th, 2025, 11:00-12:00

Seminar Room (015) of Building 51 (Marcus Campus)

Atomic layer processes- a toolbox for materials for sustainability

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Abstract:

Global problems such as plastic pollution and the growing demand for clean water necessitate the development of innovative processes and materials with unprecedented nanoscale control over composition and structure. Atomic layer processes, such as atomic layer deposition (ALD) and molecular layer deposition (MLD), are powerful and highly controlled techniques for thin, conformal growth of inorganic, hybrid, and organic materials using vapor precursors. More recently, vapor phase infiltration (VPI) emerged as a complementary technique, leveraging ALD chemistry to grow inorganic materials within polymers, resulting in hybrid materials with unique properties.

This talk will explore how ALD, MLD, and VPI can be harnessed to address critical sustainability challenges. First, we have developed ZnO VPI and ALD processes that enable efficient ZnO growth on polymer surfaces with low nucleation affinity, forming nanometric UV-absorbing coatings that extend polymer lifetimes and reduce plastic waste. Second, we utilized Al_2O_3 VPI and ALD to modify uni-porous, self-assembled block copolymer membranes, effectively tuning pore sizes from ultrafiltration to nanofiltration. This Al_2O_3 interface modification also enables precise control over pore composition, enhancing selectivity for nano-pollutants. Third, we demonstrate how MLD can be employed to grow layer-by-layer crosslinked aromatic polyamides on ultrafiltration support membranes, producing highly smooth, ultra-thin composite (TFC) membranes. These MLD-derived polyamide TFC membranes exhibit high density, a high degree of cross-linking, excellent water permeability, and superior salt rejection. This highly controlled, versatile growth process opens a new pathway of membrane fabrication for separation processes- building membranes one monomer at a time.

Bio:

Tamar Segal-Peretz is an Associate Professor at the Wolfson Department of Chemical Engineering at the Technion- Israel Institute of Technology. She received her PhD from the Technion, followed by a Director's Postdoctoral Fellowship at Argonne National Laboratory and the Pritzker School for Molecular Engineering at the University of Chicago. Tamar Segal-Peretz's group, the Functional Nanostructure and Advanced Imaging (FNAI) lab, focuses on understanding and developing functional nanostructures for water technologies, sustainable plastics, and smart materials and by combining polymer nano-structuring and atomic layer deposition processes on, within, and of polymers. Tamar also currently serves as the Chair of the Israel Microscopy Society (ISM).

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