# Seminar

*Department of Materials Engineering*
*(joint with Mechanical Engineering)*

**Thursday, November 20th, 2025, 11:00-12:00**
*Seminar Room (015) of Building 51 (Marcus Campus)*

# Stochastic Mechanics Across Scales: From Dislocations to Architected Materials

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## Abstract:

Understanding and predicting mechanical behavior from fundamental building blocks remains one of the key challenges in materials engineering. Yet, this challenge also offers new opportunities for designing materials with tailored mechanical performance. In this seminar, I will present a series of studies in multiscale materials modeling that explore how stochastic mechanical properties emerge across different length scales. In the first part of the talk, I will discuss how microstructural features drive stochastic behavior at the nanoscale. A statistical model will be introduced to describe the distribution of yield strength in nucleation-controlled plasticity, linking it to the activation parameters of dislocation nucleation and their temperature dependence. Using molecular dynamics (MD) simulations, we demonstrate how stochastic effects influence deformation in nanoparticle compression and the tensile behavior of metallic nanowires. I will also present results on bicrystalline twinned gold and penta-twinned silver nanowires, illustrating how competing microstructural mechanisms govern their failure strain and mechanical reliability. structures, where stochasticity naturally arises from their complex topology. Through extensive MD simulations of nanoporous gold, we reveal how stochastic variations in structure enhance yield strength without increasing weight. Drawing inspiration from nature, this approach opens new pathways for designing lightweight, high-performance materials. The seminar will conclude by demonstrating how MD simulations and finite element modeling (FEM) together inform the design of next-generation structural materials.

**Bio:**

Associate Professor Dan Mordehai, from the Faculty of Mechanical Engineering at the Technion, specializes in multiscale materials modeling. He earned his Ph.D. in Physics from Tel Aviv University and conducted postdoctoral research at CEA, France, and the Technion's Materials Science and Engineering Department. His work integrates atomic-to-continuum techniques to model nucleation-controlled plasticity, stochastic and lattice-like lightweight structures, mechanical properties under extreme conditions and fundamental dislocation behavior, bridging scales to reveal underlying mechanical properties.

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