Seminar

Department of Materials Engineering

Thursday, November 27th, 2025, 11:00-12:00

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

Unveiling Defects and Charge Carrier Dynamics in 3D and 2D Perovskites Using High-Sensitivity Spectroscopic Techniques

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Abstract:

Non-radiative recombination of electronic charge carriers via defect states in the bulk and at semiconductor interfaces significantly limits the performance of optoelectronic devices, including solar cells, photoelectrochemical cells, and light-emitting diodes. Detecting and characterizing deep bulk and interfacial defect states is, therefore, crucial for identifying performance-limiting factors in electronic devices. However, defect characterization poses both technical and scientific challenges due to the low density of defect states in high-quality semiconductors and the buried nature of most hetero-interfaces.

In this talk, I will demonstrate how a combination of high-sensitivity, contactless techniques—such as time-resolved and light-modulated surface photovoltage (SPV) and Constant Final State Yield Spectroscopy (CFSYS)—can directly probe the energetic location of defects in various semiconductor families. These include 3D and 2D halide perovskites (HaPs) and emerging lead-free double perovskites. [1]

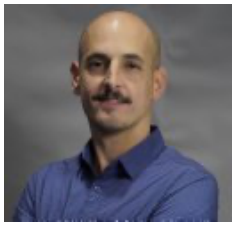
Additionally, I will demonstrate how time-resolved SPV measurements, spanning timescales from nanoseconds to seconds, provide valuable insights into fundamental charge carrier dynamics at buried interfaces of optoelectronic materials. These insights range from the dissociation and recombination of excitons in emerging HaPs to charge transfer kinetics and trapping/de-trapping mechanisms at interfaces between charge-selective layers and HaPs. [2]

References:

[1] I. Levine, D. Menzel, A. Musiienko, R. MacQueen, N. Romano, M. Vasquez-Montoya, E. Unger, C. Mora Perez, A. Forde, A. J. Neukirch, others, J. Am. Chem. Soc. 2024, 146, 23437.

[2] I. Levine, A. Al-Ashouri, A. Musiienko, H. Hempel, A. Magomedov, A. Drevilkauskaite, V. Getautis, D. Menzel, K. Hinrichs, T. Unold, S. Albrecht, T. Dittrich, Joule 2021, 5, 2915.

Bio:



Dr. Igal Levine is an Assistant Professor at the Hebrew University of Jerusalem (HUJI), in the institute of Chemistry, where he heads the new Defect Spectroscopy Research Group, established in July 2023. His expertise lies in semiconductor physics, electronic defect characterization, nanotechnology, and optoelectronic devices, particularly solar cells. Igal completed a double degree in Chemistry and Chemical Engineering in Ben Gurion University ("Nano track"). He then continued to M.Sc. studies in the field of Molecular Electronics at the Weizmann Institute. After a short period in industry R&D at HP-Indigo, he earned his PhD from the Weizmann Institute focusing on photophysical processes in novel semiconductors. After obtaining his PhD, Igal conducted his postdoctoral studies at the Helmholtz Center for Materials and Energy in Berlin, where he focused on novel spectroscopic methods for defect and charge transfer characterization in semiconductors. Igal has published more than 47 papers, has extensive research collaborations in leading institutes in Europe and the US, and is passionate to continue developing novel spectroscopic methods for further development of novel energy harvesting materials and green energy production.

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