Department of Chemistry
Faculty of exact sciences
Bar-Ilan University

המחלקה לכימיה
הפקולטה למדעים מדויקים
אוניברסיטת בר־אילן

The Department of Chemistry Weekly Seminar

Monday 20/12/21 12:00pm (refreshments 11:45am)

Defect Hunting in Halide Perovskites

DR. IGAL LEVINE
(DIVISION OF SOLAR ENERGY RESEARCH HELMHOLTZ-ZENTRUM BERLIN)

Non-radiative recombination of electronic charge carriers in a semiconductor via defect states can strongly limit the performance of optoelectronic device such as solar cells. Therefore, detecting and characterizing deep defect states in the band gap of semiconductors is important for identifying limiting factors in electronic devices, and constitutes a necessary step for further device development, as well as presenting often a technical and scientific challenge. Direct detection of defects in halide perovskites (HaPs) by standard methods utilizing optical excitation is quite challenging, due to the relatively low density of defects present in these family of materials ($\leq 10^{15}$ cm-3).

In this talk I will show how the use of a combination of high-sensitivity contactless techniques such as modulated surface photovoltage (SPV) and low-energy photoelectron spectroscopy, can directly probe the energetic location of defects in the bulk of Br-based wide-bandgap (Eg > 2eV) HaPs, and explain the significant open-circuit voltage losses in solar cells based on Br-based HaPs.

In addition, I will show how time-resolved SPV and time-resolved Photoluminescence provide complementary information on charge transfer kinetics and trapping/de-trapping mechanisms at different charge selective layers / HaP interfaces. A minimalistic kinetic model based only on rate equations has been developed for the simulation of SPV transients, allowing quantification of the density of interface traps and the hole transfer rate constants for different charge selective layers. Finally, I will show how these extracted quantities correlated very well with the resulting performance of the corresponding solar cells, and explain the recent world record photoconversion efficiency of perovskite / silicon tandem solar cells.

Location: Seminar room 112

Looking forward to seeing you!