

CPP 8: Hybrid and Perovskite Photovoltaics I

Time: Monday 15:00–16:00

Location: H38

Invited Talk

CPP 8.1 Mon 15:00 H38

The Nanoscale Photovoltaics Laboratory on a Tip — ●STEFAN WEBER — Institute for Photovoltaics, University of Stuttgart — Max Planck Institute for Polymer Research

Electrical scanning probe microscopy (SPM) modes are ideal for nanoscale photovoltaic measurements. I will discuss our recent work on developing specialized SPM techniques to study hybrid perovskite materials. Optimizing perovskite solar cells requires understanding energy losses, instability, and aging processes. These macroscale properties result from the interplay between nanoscale structure and function, including twin domains, grain boundaries, interfaces, and crystal grain orientations. Using static and time-resolved Kelvin probe force microscopy (KPFM), we can map the local surface potential, surface photovoltage (SPV), and cross-sectional potential distributions under operating conditions. With Nano-SPV spectroscopy, we achieve 10–20 nm lateral- and sub-millisecond temporal resolution. Our research aims to address key challenges in perovskite research, such as phase segregation, degradation, and interface heterogeneity, advancing understanding of loss mechanisms and instabilities in MHP solar cells.

CPP 8.2 Mon 15:30 H38

Sputter-Deposited TiO_x Thin Film as a Buried Interface Modification Layer for Efficient and Stable Perovskite Solar Cells — ●XIONGZHUO JIANG¹, KUN SUN¹, ZERUI LI¹, ZHUIJUN XU¹, GUANGJIU PAN¹, YUSUF BULUT^{1,2}, BENEDIKT SOCHOR², MATTHIAS SCHWARTZKOPFF², KRISTIAN A. RECK³, THOMAS STRUNSKUS³, FRANZ FAUPEL³, STEPHAN V. ROTH², and PETER MÜLLER-BUSCHBAUM¹ — ¹TUM School of Natural Science, Chair for Functional Materials, 85748 Garching, Germany — ²Deutsches Elektronen-Synchrotron (DESY), 22607 Hamburg, Germany — ³Lehrstuhl für Materialverbunde, Institut für Materialwissenschaft, Christian Albrechts-Universität zu Kiel, 24143 Kiel, Germany

It is crucial to suppress the non-radiation recombination in the hole-blocking layer (HBL) and at the interface between the HBL and active layer for performance improvement. Herein, TiO_x layers are deposited

onto a SnO₂ layer via sputter deposition at room temperature, forming a bilayer HBL. The structure evolution of TiO_x during sputter deposition is investigated via in situ grazing-incidence small-angle X-ray scattering. After sputter deposition of TiO_x with a suitable thickness on the SnO₂ layer, the bilayer HBL shows a suitable transmittance, smoother surface roughness, and fewer surface defects, thus resulting in lower trap-assisted recombination at the interface between the HBL and the active layer. With this SnO₂/TiO_x functional bilayer, the perovskite solar cells exhibit higher power conversion efficiencies than the unmodified SnO₂ monolayer devices.

CPP 8.3 Mon 15:45 H38

Dynamics and kinetics of light-induced phase segregation in MAPbBr_{1.8}I_{1.2} perovskites — ●IVAN ZALUZHNYI¹, LINUS PITHAN², RUSTAM RYSOV², FREDERIK UNGER^{1,2}, JAKUB HAGARA¹, EKATERINA KNESCHAUREK¹, PAUL ZIMMERMANN¹, SEBASTIAN SCHWARTZKOPFF¹, LENA MERTEN¹, DMITRY LAPKIN¹, ALEXANDER HINDERHOFER¹, FABIAN WESTERMEIER², MICHAEL SPRUNG², YANA VAYNZOF^{3,4}, FABIAN PAULUS^{5,4}, and FRANK SCHREIBER¹ — ¹University of Tübingen — ²Deutsches Elektronen-Synchrotron DESY — ³Technical University of Dresden — ⁴Center for Advancing Electronics Dresden (cfaed) — ⁵IFW Dresden

Hybrid organic-inorganic perovskites tend to undergo several structural transformations that can be caused by temperature, humidity and light. Here we use X-ray photon correlation spectroscopy (XPCS) to study the dynamics of light-induced phase segregation in MAPbBr_{1.8}I_{1.2} and the formation of Br-rich and I-rich domains. We observe that the phase segregation is characterized by three distinct time scales corresponding to the rapid formation of small seeds of the I-rich phase, fluctuations of the ion distribution around the quasi-equilibrium state (dynamics), and a directional drift of the ions within the crystal grains (kinetics). We also observe the influence of defects in the halide sublattice on phase separation and find that samples with interstitial halides exhibit slower phase separation as samples with vacancies in the halide sublattice.