Scale-bridging, multi-modal characterization of metal halide perovskite materials and devices

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Organic-inorganic hybrid metal halide perovskite solar cells show exceptional optoelectronic properties in line with low-cost and large-scale fabrication and have demonstrated a leap forward in power conversion efficiency (PCE). PCEs emerged from 3.8% in initial studies [1] to today's certified 25.5% (single-junction) and close to 30% (perovskite-silicon tandem devices) [2]. The main challenge prior to large scale commercialization of this type of solar cells, is now to improve long term stability at the module level.

Here, the interplay of multi-modal, scale-bridging (macro to nano) materials and device characterization with probes like focused electron, ion or laser beams and tips and will play a significant role to further advance long term stability, sustainability and recyclability.

In this presentation I will provide for combined tomography, microscopy and spectroscopy results, demonstrate the data overlaying and correlation using the nanoGPS technology [3] and will demonstrate the importance of sample preparation workflows with inert and cryo options where needed. Pristine samples and mini-modules after degradation in real world environments will be presented and compared with respect to opto-electronic, structural and interfacial properties.

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[1] *Kojima et al.,* J. Am. Chem. Soc. *131, 17 (2009)*
[2] https://www.pv-magazine.com/2020/01/30/tandems-cells-approaching-30-efficiency/
[3] *Acher et al., Meas. Sci. Technol. 32, 045402 (2021)*