Halide perovskite degradation in contact to metal oxides

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For optoelectronic devices the function and performance depends crucially on the proper choice of charge transport layers. For halide perovskite-based devices, not only energetic barriers arising between the transport levels of the various layers in the device will affect the overall performance, it is becoming more and more obvious that interactions between the perovskite and the adjacent layers play a crucial role. In particular, the direct contact to metal oxides seems to trigger chemical reactions that can lead to a partial or even complete decomposition of the perovskite film.

In this talk, I will summarize our work on a variety of organic and metal oxide transport layers in contact to perovskites, where we use photoelectron spectroscopy to analyze the degradation process. [1-7] To gain a deeper understanding, we investigated a variety of different perovskites (i.e. organic vs. inorganic ones, I vs. Br, etc.) as well as the individual perovskite precursors. We find that the reactivity strongly depends on the individual material combination and that different metal oxides show fundamentally different reaction/ degradation pathways.

Particular attention will be given to MoO_3, ZnO, and NiO_x, where in collaboration with the theory groups of Shuxia Toa (TU Eindhoven) [5,6] and Maytal Toroker (Technion) [7] we have developed a deep understanding of the underlying degradation processes. Based on these insights we were also able to explore possible strategies to mitigate the degradation, either by controlling the defect density on the metal oxide or by employing passivating agents.

Overall, I will show how photoelectron spectroscopy measurements can help to probe and understand the processes going on at these various bottom contact interfaces to perovskite, which should ultimately help to improve the stability of perovskite related devices.

References:

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