

# Surface Functionalization of Metal Oxides for Hybrid Organic-Inorganic Lead Halide Perovskite Optoelectronics

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Metal oxide materials are commonly used as bottom charge transport layers in hybrid organic-inorganic metal halide perovskite optoelectronics, since they can enable improved stability compared to organic charge transport layers. These include TiO<sub>2</sub>, SnO<sub>2</sub>, and ZnO as electron transport layers, and NiO<sub>x</sub> as hole transport layers. However, metal oxide materials do not necessarily exhibit favorable energy level alignment with the perovskite layer, and perovskite deposition on the metal oxide surface commonly results in differences in crystallization compared to organic materials, and differences in interfacial defects which then affect the device performance. Here we will discuss different surface modifications of the metal oxide surfaces, and the influence of both chosen material for surface modification as well as metal oxide properties on the effect of the modification on the device performance.