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Interface Engineering in Metal Halides Perovskites: from molecules to devices.

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In this talk we review our recent studies which aim to clarify the relationship between structural and electronic properties from a molecular to mesoscopic level. First we identify the markers for local disorder at molecular level by using Raman Spectroscopy as a probe. Then, we exploit such a tool to explore the role of microstructure on the absorption and emission properties of the semiconductor looking both at polycrystalline thin films and single crystals. We address the controversy surrounding electron hole interactions and excitonic effects. We show that in hybrid lead-halide perovskites dielectric screening also depends on the local microstructure of the hybrid crystals and not only on its chemical composition. This leads to the possibility of band gap engineering and the consequent control of the elementary photo-excitation dynamics that determine the perovskites performances in different optoelectronic devices. Finally, the role of interface engineering, the effect of ion migration, and interface doping on charge extraction will be elucidated to provide a guideline for the design of hysteresis free solar cells. 1)G. Grancini AR Srimath Kandada et al, Nature Photonics, 9 (10), 695-701, 2015 2) C. Tao et al, Energy Environ. Sci.,8, 2365-2370, 2015