

Defect passivation in “soft” halide perovskite materials for photovoltaic applications

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Defects can either boost charge transport (generating extra free charge carriers by doping) or impede it by trapping or scattering the carriers.¹ Defects associated with deep trap states in halide perovskites (e.g. undercoordinated halides ions, undercoordinated Pb^{2+} ions) promote non-radiative recombination, leading against a high photovoltage, hampering the ultimate device efficiency.²⁻⁴ Shallow defects, on the contrary, are considered benign in classical inorganic semiconductors and have little contribution to non-radiative recombination, not strongly influencing the efficiency of the device. This high tolerance to shallow defects is what makes the perovskite family known as *defect-tolerant*.⁵ However, the ionic-electronic characteristics of halide perovskites, together with their “soft material” nature, indicates a strong ionic component where charged shallow level traps with low formation energies (e.g. I or MA vacancies) results unfavourable for the solar cell, causing ion migration, phase segregation and hysteresis.³⁻⁵ This is especially detrimental for the PSC under non-equilibrium conditions, such as high temperature, electrical bias, continuous light irradiation or their combination, where ion migration dictates the long-term stability of operational PSCs. In this talk we will present our most recent work on defect passivation of halide perovskite solar cells to fabricate highly efficient and highly stable perovskite solar cells.⁶

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Halide Perovskites

“Soft” Mixed Ionic Electronic Conductors

Lattice deformation and strain energies that can break most classical semiconductors

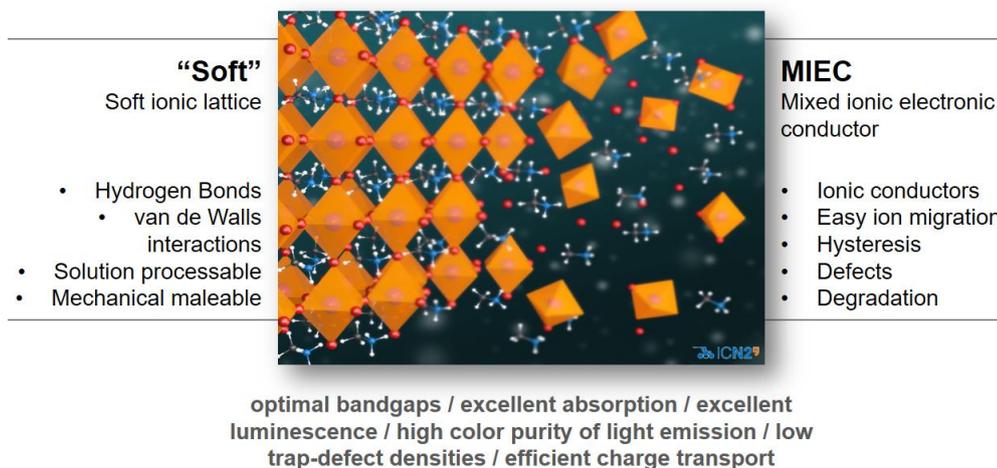


Figure 1: The “soft” nature of halide perovskites.