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Halide perovskites prepared by a fast microwave-assisted route

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Halide perovskites (HP) have emerged as extremely attractive materials for photovoltaic and optoelectronic devices such as solar cells, light emitting diodes, light amplifiers, photodetectors or lasers.[1] Beyond their excellent optoelectronic properties, HP materials have a great versatility as their properties can be adjusted by changing the elements of its ABX_3 formula, where X = Cl, Br, I; B is a divalent metallic cation, Pb in the current most efficient materials and A is monovalent cation.

HP are traditionally synthesized in solution, via “hot injection”, which suffers from low yields and complex synthetic procedures (inert atmosphere, accurate temperature control and long reaction times). A new microwave (MW)-assisted synthesis was reported for the first time in 2017 as a fast, low cost and easy procedure to prepare $CsPbX_3$ materials.[2,3]

Our group has extended the use of a MW synthetic approach to design diverse HP families. The MW heating facilitates a different way of nucleation and growth of ABX_3 crystals, and provides the advantages of working very fast and under air conditions, but preserving their characteristic optoelectronic properties. In this work, the most interesting results on all-inorganic $CsPbX_3$ (with X: Cl, Br, and Cl/Br mixtures) and hybrid $FAPbI_3$ (FA: formamidinium) perovskites will be presented. For instance, we will discuss on how to modulate the band gap and photoluminescence quantum yield (PLQY) of $CsPbX_3$ nanocrystals by modifying the stoichiometry of the halide ions (Figure 1a-b). We will also present the stabilization of the black phase $FAPbI_3$ material (Figure 1c-d), which has in fact the lowest bandgap of the family, 1.48 eV, with a maximal theoretical (PCEmax) of 32.3%, and consequently being the most attractive material for solar cells.

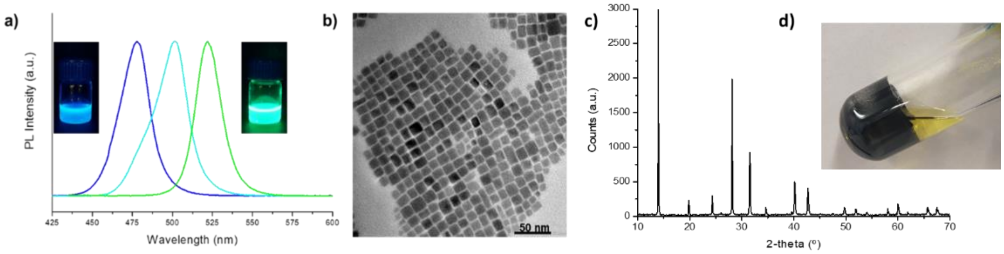

Figure 1. a) PL emission spectra (inset: PL upon 365 nm excitation) and b) TEM micrograph of MW-synthesized $CsPb(Cl,Br)_3$ perovskite NCs; c) XRD and d) picture of MW-synthesized $FAPbI_3$ material.

References

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