Solgel2022

TOWARDS MORE EFFICIENT AND SUSTAINABLE HALIDE PEROVSKITES FOR PHOTOVOLTAICS AND OPTOELECTRONICS

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ABSTRACT:

Metal-halide perovskites (MHP) have emerged as extremely attractive and versatile materials for a broad range of technological applications including photovoltaics, lighting and displays, lasers, photocatalysis and photoelectrochemistry. [1,2] The reason lies on their exceptional optoelectronic properties, which can be easily tuned by changing the elements of its ABX_3 formula (A: monovalent cation, B: Pb in the current most efficient materials, and X: Cl, Br and/or I). Furthermore, their synthesis in solution has enable to prepare both films and brightly luminescent MHP colloidal solutions.
A significant progress in the shape-controlled synthesis and surface passivation of MHP nanocrystals and the advance in understanding and performance of Pb-based perovskite devices has been achieved. Nevertheless, the tedious synthetic procedures (N_2 and vacuum cycles), the low stability of some crystalline phases and the toxicity of Pb remain as some of the most challenging problems to solve for a real application.

This presentation will show our latest contributions towards the development of more efficient and sustainable metal halide perovskites facilitated by sol-gel chemistry. We will address the ligand and band gap engineering for achieving high quality and ultra-stable $CsPbI_3$ quantum dots that are useful for deep red light emitting diodes (Fig.1a).[3] We will also focus on the use of a microwave (MW)-assisted route for the fabrication of halide perovskites. Indeed, the microwave heating not only allowed the advantage of working very fast and under air conditions, but also the stabilization of metastable phases such as tetragonal instead of cubic $CsPb(Cl,Br)_3$ nanocrystals (Fig. 1b), or the interesting black phase of $FAPbI_3$ (Fig. 1c). The optoelectronic properties and performance of the devices fabricated with these halide perovskites (i.e. blue-green LEDs with $CsPb(Cl,Br)_3$ and solar cells with $FAPbI_3$) will be presented. This approach was also successful in the synthesis of bright emitting lead-free perovskite materials from low-cost and abundant reagents.

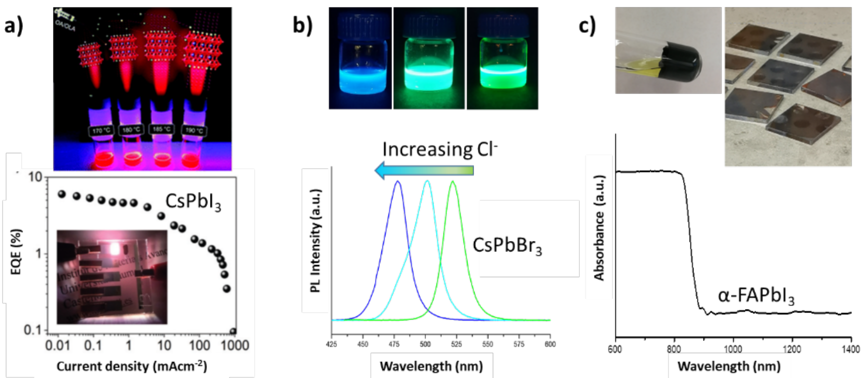

Figure 1: a) EQE and picture of a LED prepared with $CsPbI_3$ quantum dots, b) PL spectra and picture of $CsPb(Cl,Br)_3$ colloidal solutions, c) VIS-NIR absorbance and picture of $FAPbI_3$ powder and films.

References

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