Two Dimensional organic-inorganic perovskite from nanostructures to solar cells

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Perovskite is a promising light harvester for use in photovoltaic solar cells. In recent years, the power conversion efficiency of perovskite solar cells has been dramatically increased, making them a competitive source of renewable energy.

This work will discusses new directions related to organic inorganic perovskite and their applications in solar cells.

In low dimensional systems, stability of excitons in quantum wells is greatly enhanced due to the confined effect and the coulomb interaction. The exciton binding energy of the typical 2D organic-inorganic perovskites is up to 300 meV and their self-assembled films exhibit bright photoluminescence at room temperature.

❖ In this work we will show the dimensionality in the perovskite structure. The 2D perovskite structure should provide stable perovskite structure compare to the 3D structure. The additional long organic cation, which is added to the perovskite structure (in the 2D structure), is expected to provide hydrophobicity, which will enhance the resistivity of the perovskite to humidity. Moreover we will demonstrate the use of 2D perovskite in high efficiency solar cells.
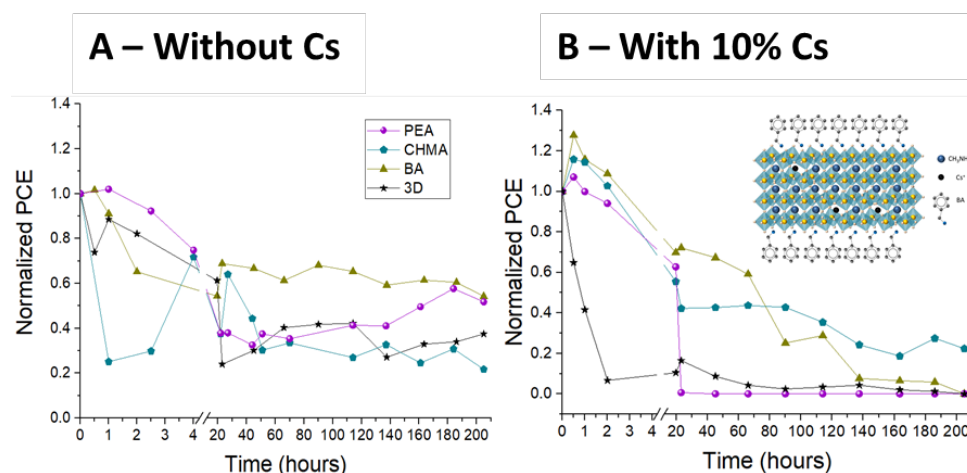

Figure 1: Stability under continuous 1 sun illumination of 2D based perovskite based solar cells with (B) and without Cs (A). [1]

❖ Organometal halide perovskite is used mainly in its "bulk" form in the solar cell. Confined perovskite nanostructures could be a promising candidate for efficient optoelectronic devices, taking advantage of the superior bulk properties of organo-metal halide perovskite, as well as the nanoscale properties. In this work, we present facile low temperature synthesis of two-dimensional (2D) lead halide perovskite nanorods and nanoparticles including the incoporaiton of the Rb into the nanopartiels.
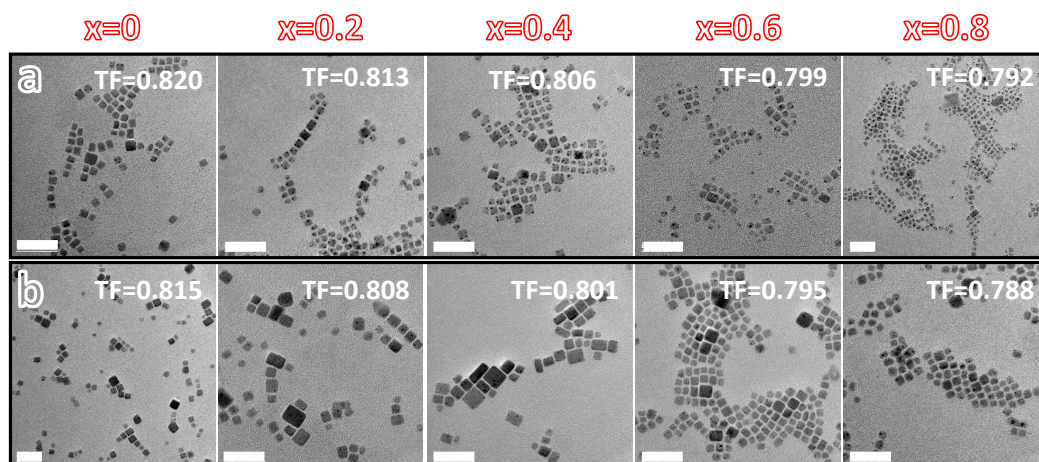
Figure 2: $Rb_xCs_{1-x}PbY_3$ (where Y=Cl or Br) NPs. the X indicates the Rb content inside the NPs. TF corresponds to tolerance factor. [2]

References

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2. Daniel Amgar, Tal Binyamin, Vladimir Uvarov and Lioz Etgar, Nanoscale, 2018, 10, 6060–6068