A new synthetic approach for size-tunable and stable $CsPbBr_3$ nanocubes with near-unity photoluminescence quantum yield

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Cesium lead-halide perovskites nanocrystals (NCs) are composed of cuboctahedral structures with a marked ionic nature and chemical formula $CsPbX_3$, in which Cs^+ is surrounded by eight corner-sharing PbX_6^{4-} octahedra with their vertices occupied by halides.[1] Due to their potential near-unity photoluminescence quantum yields (PLQY), narrow emission profiles, and tunable fluorescence peaks in the green region, $CsPbBr_3$ NCs can be considered the ideal candidates for optoelectronic devices.[2] On this ground, it is of high importance the development of a general synthetic route capable of combining the best of photophysical properties characterizing $CsPbBr_3$ NCs with a sufficient stability, rarely observed in this class of nanomaterials. In this presentation, starting from our recent studies on perovskite NCs,[3] we will describe a synthetic protocol for the obtainment of near-unity PLQY perovskite nanocubes ensuring their size control and, consequently, a narrow and intense emission through the modification of the reaction temperature and the suitable combination ratio of the perovskite constituting elements. The peculiarity of this protocol is represented by the dissolution of the lead precursor ($PbBr_2$) as a consequence of complexation with the bromide anions released by the in situ SN_2 reaction between oleylamine (the only surfactant introduced in the reaction mixture) and 1-bromohexane (Figure 1A). By varying the synthetic parameters, the obtained $CsPbBr_3$ nanocubes exhibited *i*) variable size (ranging from 6.7±0.7 nm to 15.2±1.2 nm), *ii*) PL maxima between 505 and 517 nm, and *iii*) near-unity PLQY with a narrow emission profile (fwhm of 17−19 nm) (Figure 1B-C).

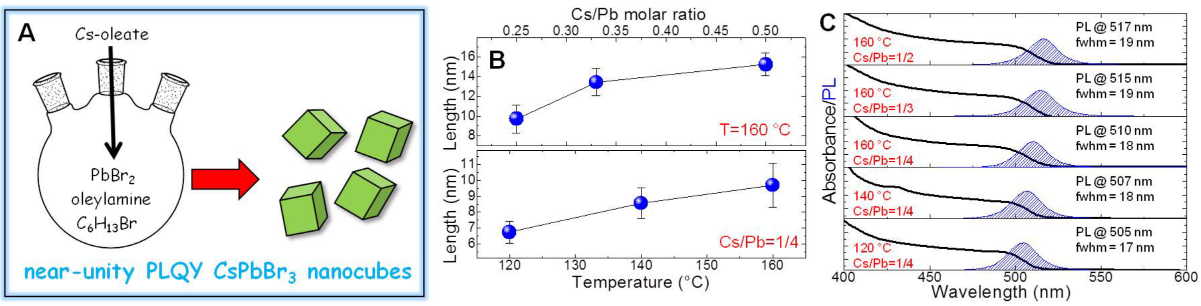

Figure 1. (A) Synthetic scheme, (B) sizes and (C) optical properties of near-unity PLQY perovskite NCs as a function of the experimental conditions.

Additionally, the NCs synthesized by this approach preserved their high PLQYs even after 90 days storage under ambient conditions. Therefore, the proposed synthetic protocol can provide new insights for the direct preparation of differently structured perovskite NCs without resorting to any additional post-synthetic treatment for improving their emission efficiency and stability.

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