Full-color tuning in binary polymer:perovskite nanocrystals organic-inorganic hybrid blends

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Supplementary Informations

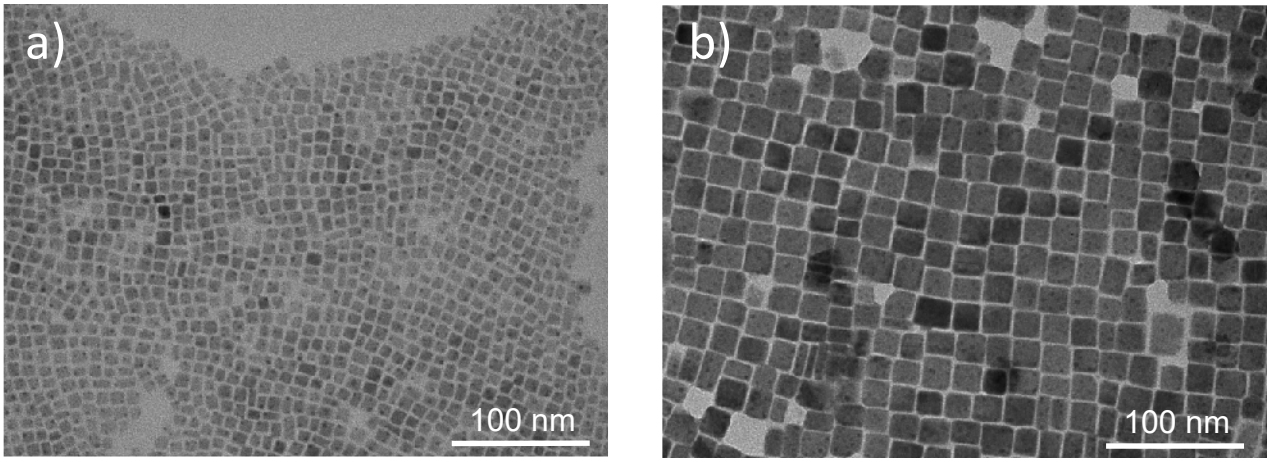

Fig S1: a) TEM image of the $CsPbBr_3$ nanocrystals. b) TEM image of the $CsPb(BrI)_3$ nanocrystals.

Nanocrystal characterization

In order to caracterize the green $CsPbBr_3$ NCs and the red $CsPb(BrI)_3$ NCs we measured the Photoluminescence Quantum Yield (PLQY), by following the procedure in Ref. [1].

The PL QY of $CsPbBr_3$ NCs in toluene against Fluorescein in NaOH 0.1M (exc. λ=488 nm) was 64.7%, while the PLQY of $CsPb(BrI)_3$ NCs in toluene against Rhodamine 6G in ethanol (exc. λ=530 nm) was 67.2%, both evidencing a high quality of the materials.

The NCs shape and size distribution has been investigated by TEM measurements by using a Hitachi HT7700 EXALENS microscope operated at 100 kV.

We observe (see Fig. S1) an almost cubic shape in both samples with an average side length of 8.71±1.1 nm and 19.3±2.7 nm for $CsPbBr_3$ and $CsPb(BrI)_3$ NCs, respectively.

Total FRET lifetime

The total FRET lifetime has been determined starting from the FRET rate (k'_{fret}) dependence on the donor acceptor distance r, on the donor lifetime τ_d and on the Forster radius R_0, given by:

$$k'_{fret} = \frac{1}{\tau_d}\left(\frac{R_0}{r}\right)^6$$

Assuming a uniform acceptor distribution, with a volume density ρ_a, and a minimum donor acceptor distance d it is straigthforward to demonstrate that the total FRET rate K_{fret} is given by:

$$K_{fret} = \frac{12\pi\rho_a}{\tau_d}\frac{{R_0}^6}{d^3}$$

Finally considering d as the average distance between the nanocrystal center and its surface, and assuming a cubic NC shape with side length L we have d≅0.6L.

The nanocrystal volume density has been estimated starting from the F8BT mass density [2] of 749 kg/m^3, converting it in molecule density by using a Molecular Weight of 42000 (as provided by ADSdyes), and mulptiplying the result with the percentage fraction of NCs in the film.

We observe that our assumptions likely lead to underestimate the real minimum donor-acceptor distance, as we neglect the size of the ligands on the NC surface, the polymer molecule size, and the eventual presence of NC clustering that could avoid a close contact between donor and acceptor. Thus the real average donor acceptor distance is expected to be larger than our estimate, and thus the estimated FRET rate is expected to be a higher limit of the real one, and the FRET lifetime a lower limit.

References

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[2] B. Watts, P. Warnicke, N. Pilet and J. Raabe, *Phys. Statu Solidi A* **212**, 518–522 (2015)