Luminescent Properties of $CsPbBr_3$ Halide Quantum Dots Incorporated In Solid Matrix

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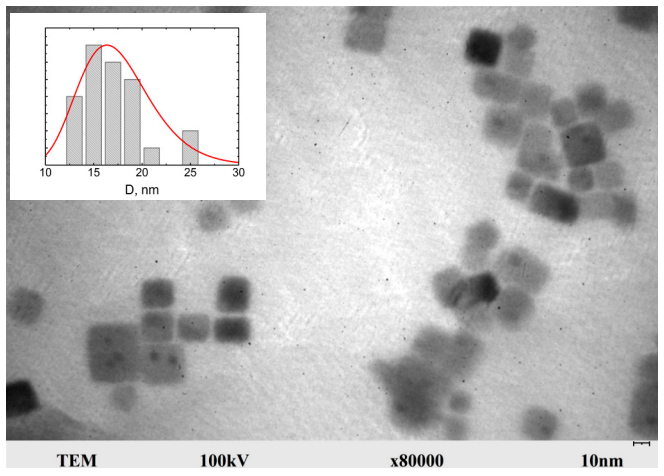
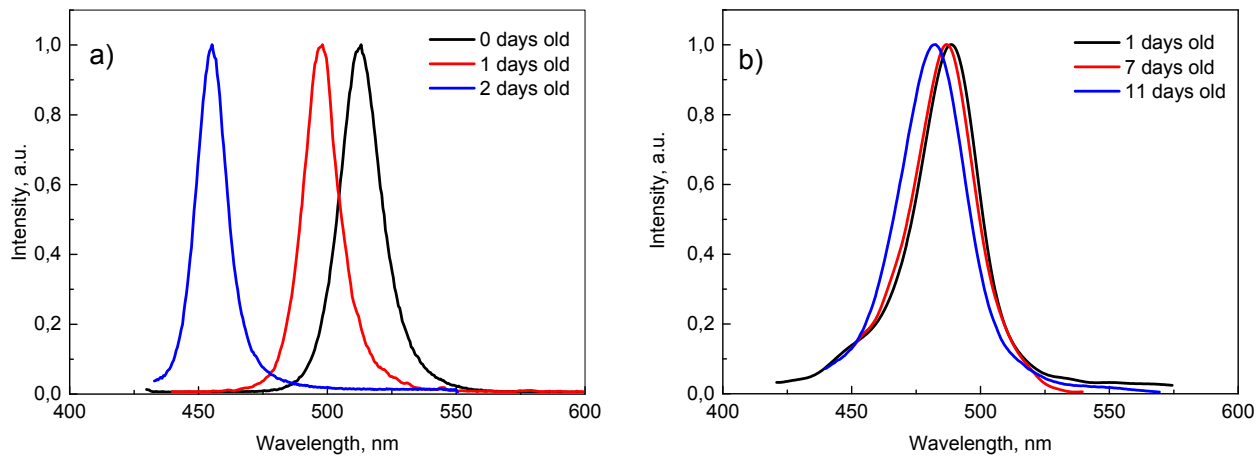
In the last years, all-inorganic cesium lead halide perovskite nanocrystals ($CsPbX_3$, X = I, Br, and Cl) have attracted significant interest due to their high photoluminescence quantum yield, fast decay and narrow emission bands at visible region of spectrum [1]. Such perovskite quantum dots are perspective for LED, lasers, solar cells and other applications. However, these nanocrystals suffer from poor stability under the influence of external factors such as moisture, heat, light etc. [2]. One of the ways to enhance their stability is to encapsulate such nanocrystals in inert and transparent hosts or matrices, and, subsequently, such bulk luminescent materials can be used for various technical applications.

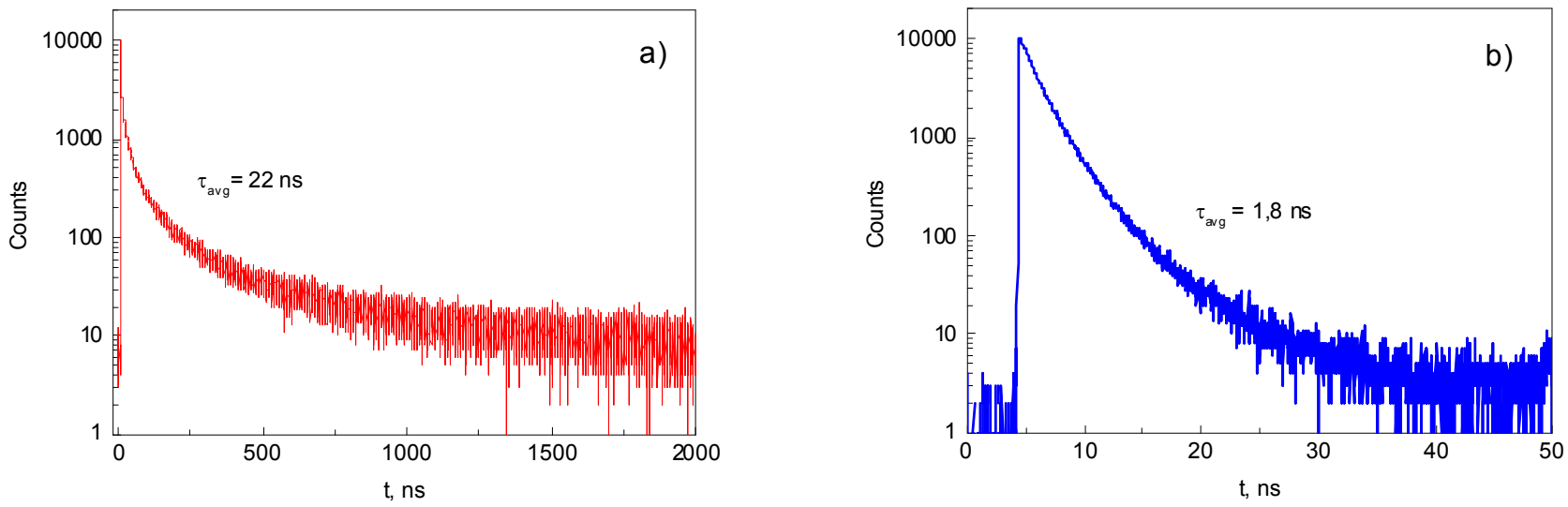
In this work, the colloidal solutions of the $CsPbBr_3$ perovskite quantum dots in chloroform were synthesized by ligand-assisted reprecipitation (LARP) technique and then these quantum dots were incorporated in polymethyl methacrylate (PMMA) film. The stability and luminescent properties of encapsulated perovskite quantum dots has been investigated.



TEM image of the $CsPbBr_3$ nanocrystals



Luminescence spectra of $CsPbBr_3$ solution (a) and $CsPbBr_3$-PMMA film (b)



Decay curves of $CsPbBr_3$ solution (a) and $CsPbBr_3$-PMMA film (b)

- Luminescence spectra of $CsPbBr_3$ nanocrystals in solution are shifted to the blue region of the spectrum within 2 days, which is associated with the high instability of halide perovskites.
- Luminescence spectra of $CsPbBr_3$ nanocrystals incorporated in PMMA film remain almost unchanged for 11 days.
- Decay curves of perovskite nanocrystals in solution are strongly non-exponential and have the long-time component.
- After incorporation in PMMA film, average luminescence decay time of $CsPbBr_3$ perovskite nanocrystals decreases from 22 ns to 1.8 ns, and the long-time component disappears.

[1] L. Protesescu, S. Yakunin, M.I. Bodnarchuk et al. Nano Letters. 15 (2015) 36923696.

[2] G. Schileo, G. Grancini. J. Phys. Energy. 2 (2020) 021005

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