Direct Color Tuning of Pure CsPbBr3 Nanocrystals as a Potential Material for LEDs with Bright Emissions

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Perovskites have emerged with great promise for practical applications, such as LEDs, solar cells, photodetectors, and lasers. They are known as tunable materials for use in LEDs. Tuning is luminescence color modulation in optoelectronics. In 2015, Kovalenko's research group managed to make a highly luminescent tunable nanocrystals (NCs) by mixing cesium lead halides (CsPbX3 (X= I-, Br-, Cl-). Out of the 3 halides, CsPbBr3 showed impressive optical results with the highest efficiencies. In this project, CsPbBr3 NCs emissions were tuned by shrinking their size without any changes on the chemical compound while conserving the remarkable properties. Four samples of CsPbBr3, which has a green luminescence, were prepared. Carbazole was added to three of them while the forth served as a control. The first sample had 1mg of carbazole for each 25µl of CsPbBr3, the second sample had 1mg:8µl, and the third sample had 1mg:4µl. The CsPbBr3 compound did not change after carbazole treatment for the three samples and was verified using X-ray diffraction (XRD). The luminescence color wavelength of the samples was measured using steady-state emission spectroscopy. The NCs size and cubic morphology were identified using transmission electronic microscope. The NCs size was reduced significantly after carbazole treatment. Higher carbazole amounts caused a bluer shift of the emission and smaller NCs size. The NCs maintained high efficiency with 64% quantum yields even after the carbazole treatment. In the future, this technology could provide TVs, phones, and most lighting applications with brighter colors for a lower price.

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