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Spectral stability of CsPbX3 (Br, I) perovskite nanocrystal for single photon emission

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In 2015, Park and colleagues generated the first room temperature perovskite based single-photon source using all-inorganic CsPbI3 quantum dots (QDs). Since then, quantum light emission from a variety of perovskite nanocrystals (PNCs) has been demonstrated at both ambient and cryogenic temperatures. Despite the remarkable features of PNCs, the use of PNCs is restricted by their photostability. The research focus has moved to their challenging integration into photonics platforms. In this study, we utilized cryogenic micro-PL and micro-TRPL spectroscopy to investigate the spectral stability, blinking, and spectral color purity of single colloidal cesium lead halide PNCs with different caping ligands. Compared to typical oleic amine/oleic acid (OLA/OA) ligands, PNCs capped with zwitterionic (ZW) ligands exhibited a significant reduction in blinking effect, along with strong linewidth narrowing and enhanced spectral stability. Additionally, a slightly longer decay time (by a factor of ~1.35) was observed for CsPbBr3 single NCs with ZW ligands, indicating a reduction in undesirable effects such as Auger recombination, making these NCs better suited for single-photon sources. However, for CsPbI3 PNCs, this strategy was ineffective, and traditional OLA/OA ligands remained the best option. For CsPbI3 NCs, we measured a second-order photon correlation function of g2(0) ~0.3, confirming their suitability for single-photon emission. Furthermore, spectral diffusion effect was significantly reduced in both single CsPbBr3 PNCs with ZW ligands and CsPbI3 PNCs with OLA/OA ligands, resulting in narrow micro-PL linewidths of ~125 μeV and ~140 μeV, respectively. Our findings pave the way for utilizing perovskites and single photon sources as key components in quantum technology-oriented applications.

Type of presence

Primary author: Dr GORJI, Setatira (Institut de Ciència dels Materials (ICMUV), Universitat de València. Catedrático José Beltrán 2, 46980 Paterna, Valencia, Spain.)

Presenter: Dr GORJI, Setatira (Institut de Ciència dels Materials (ICMUV), Universitat de València. Catedrático José Beltrán 2, 46980 Paterna, Valencia, Spain.)

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