Enhancing photoluminescence quantum yield in $CsPbBr_{3-x}Cl_x$ nanoparticles through co-doping with oleylammonium thiocyanate and organic borate additives

Aleksandrs Novikovs, Boris Polyakov
Institute of Solid State Physics, University of Latvia

Perovskite nanocrystals have received significant attention due to their potential applications in optoelectronic devices, including LEDs, photosensors, and inkjet-printed LCD displays. However, their applicability is highly dependent on the quantum yield. For example, the photoluminescence quantum yield (PLQY) of pristine blue-emitting perovskite nanocrystals is typically low and unstable. In this report, we propose a novel approach to increase the PLQY of CsPbBr3-xClx nanoparticles by co-doping them with oleylammonium thiocyanate (OLAM-SCN) and organic borate (H3BO3-EG-OLAM) additives. The CsPbBr3-xClx nanoparticles were synthesized using a hot injection method, followed by post-treatment with various dopants. Three distinct series were prepared: one doped with thiocyanates, another with H3BO3-EG-OLAM, and a third co-doped with both additives. By varying the chloride ion concentration across these series, we obtained particles with photoluminescence (PL) maxima ranging from 460 to 495 nm. Our results demonstrate that the PLQY of these nanoparticles can reach values close to 95-100% for particles with peak emission in the range of 485-495 nm. Additionally, we investigated the PLQY dependence on chlorine concentration over a three-week interval. The practical significance of this research lies in its potential impact on the development of inkjet-printed LEDs and LCD displays.

This research is funded by the ERAF project "Functional Inkjet Printing of Wireless Energy Systems" (No. 1.1.1.1/20/A/060). The Institute of Solid State Physics at the University of Latvia, as a Center of Excellence, has received funding from the European Union's Horizon 2020 Framework Program (H2020-WIDESPREAD-01–2016–2017-TeamingPhase2) under grant agreement No. 739508 for the CAMART2 project