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Polar solvent-free ligand assisted reprecipitation for the synthesis of $CsPbBr_3$ colloidal nanocrystals with tunable surface chemistry

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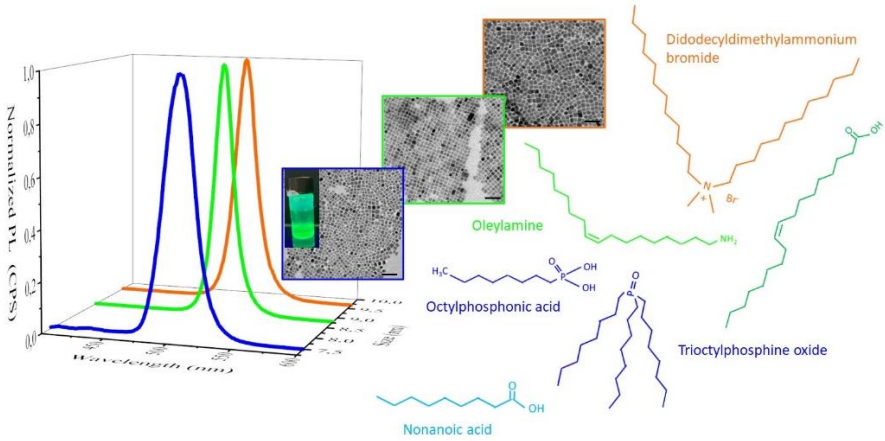
All-inorganic cesium lead halide perovskite nanocrystals (NCs) have attracted considerable scientific and technological interest in optoelectronic applications due to their precise bandgap tunability, high color purity and efficient luminescence.[1] Currently, high-quality solution-processable CsPbBr3 NCs with controlled size and shape have been synthesized via the hot-injection (HI) method, but the costly and difficult upscaling conditions hinder their commercial viability. Conversely, scalable low-cost room-temperature ligand-assisted reprecipitation (LARP) method requires only basic wet chemistry apparatus and is overwhelmingly more appealing to industry from financial and energy perspectives. Beside the conventional LARP approach, whereby the formation of NCs is burst upon addition of polar solution of precursor salts into a vigorously stirred antisolvent media, recently, new polar-solvent-free methods have been proposed. [2,3] These methods aim at overcoming the main limitations of conventional LARP approach such as poor long-term stability of NCs, poor modulation of the surface-ligand composition and low reaction yield. We have, thus, tackled these challenges and developed "unconventional" LARP approaches to achieve highly luminescent $CsPbBr_3$ NCs with tunable surface chemistry, and narrow size and shape distribution. In this work synthetic protocols in non-polar solvent have been developed using alkylamine, alkylammonium bromide or alkyl phosphonic acid as ligands, and suitable purification procedures have been established to provide colloidal NCs solution with a concentration in the micromolar range, having luminescent quantum yield over 50%, stable over months, thus offering a potential alternative to HI synthetic methods for achieving high quality $CsPbBr_3$ colloidal NCs.



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