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T1002: Synthesis and characterization of nanostructured materials

Efficient defect passivation in $CsPbX_3$ perovskite nanocrystals for 3D printing, stabilization in polar solvents and future solar-driven chemistry

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Halide perovskite nanocrystals (PNCs) are prominent and interesting nanomaterials for actively studying photovoltaics, optoelectronics, photonics, and solar-driven chemistry. Valuable features including easy preparation, narrow width at half-maximum photoluminescence (PL) peak, adjustable/modifiable surface chemistry, a notable PL quantum yield (PLQY) of up to 100%, and a modulable band gap, have been exploited to fabricate highly efficient devices such as PNC solar cells and multiple color light-emitting diodes (LEDs). Despite of above benefits of the PNCs, the PLQY and material quality are limited by their defective structure, making them prone to degradation. Factors such as (i) synthetic protocols for the PNCs formation and (ii) the loss of capping ligands from PNCs surface are pivotal to create a defective structure. In both cases, halide deficiency is the main reason to cause the appearance of a high density of nonradiative recombination sites, reducing the stability of the final product, and hindering the effective extraction of charge carriers. To overcome these drawbacks, we have analyzed the influence of natural vitamins and alkylammonium halide ligands with high binding capability, on the enhancement of the photophysical properties, stability, and suppression of non-radiative carrier traps of light emitting $CsPbX_3$ PNCs (X = Cl, Br, I). By establishing an efficient surface passivation [1,2], less defective PNCs are formed, with long-term stability, providing a better color quality. Therefore, it is possible to produce excellent candidates to improve the fabrication of luminescent 3D-printed solids, ultrastable PNCs in polar environments up to 7 months, and to conduct promising solar-driven chemical reactions to obtain added-value products.

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References

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