The effect of the alkylammonium cation on the optical and physical properties of organic-inorganic perovskite nanoparticles

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Organic-inorganic perovskites (OIPs) function efficiently as active materials in optoelectronic applications. Confined OIP nanostructures are a promising substance for efficient optoelectronic devices.

Here we present a facile, low temperature synthesis of OIP nanoparticles (NPs) of well-defined size and shape. To the best of our knowledge, this is the first time that OIP NPs are synthesized under ambient atmosphere having defined cubic shape.

As opposed to their inorganic counterparts, the synthesis of OIP NPs is quite challenging, and major efforts should be invested in finding the right ligand for the stabilization of the surface. Three alkylammonium cations ($C_8H_{17}NH_3^+$/ $C_{12}H_{25}NH_3^+$/ $C_{18}H_{37}NH_3^+$) that stabilize the NPs' surface were studied. The size and the shape, as well as the optical properties of the NPs, were affected by the length of the alkylammonium cation. The OIP NPs showed a shift in the absorbance and the photoluminescence to higher energies than the OIP bulk. This shift is an evidence for their two-dimensional (2D) nature, which was controlled by the length of the alkylammonium cations. In order to elucidate the effect of the ligands on the optical properties of the NPs, layers of 2D perovskite of the formula $(RNH_3)_2(MA)_{n-1}Pb_nX_{3n+1}$ (R is an alkylic residue of the lengths C_8, C_{12}, or C_{18}) were synthesized. It can be concluded that the length of the alkylammonium cations affects the assembly of the OIP NPs and the 2D perovskite layers. In addition, it also influences on the optical and physical properties of the NPs, thus enabling the acquisition of many desired colors from the UV to the visible.