Improving the ambient stability of PbSe nanocrystals via one-step surface engineering

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PbSe nanocrystals (NCs) have obtained great interest due to their size-tunable energy gaps, small bulk band gap (0.26 eV), and high multiple exciton generation (MEG) yield. However, oxidation vulnerability of PbSe NCs under ambient conditions still remains as drawbacks. Se sites on (100) facets are usually under-coordinated due to charge balance, so they are particularly vulnerable to oxidation. To avoid the oxidation of PbSe NCs, previous studies utilized inorganic shell growth, organic ligand control, and polymer matrices. However, for the integration of PbSe NCs into optoelectronic applications, sub-atomic layer passivation strategy is strongly required for efficient charge transport and collection.
Here, we present facile and highly effective surface engineering strategies; 1) halide adlayer formation on surface of PbSe NCs and 2) introducing different Se precursors during the synthesis. Super-stability of PbSe NCs was revealed by absorption spectroscopy. Additionally, TEM, XPS, NMR and DFT calculations were utilized to characterize and anticipate the surface of super-stable PbSe NCs.