Superfluorescence from Binary Perovskite Superlattices

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Lead-halide perovskite $APbX_3$ (A=Cs or organic cation; X=Cl, Br, I) quantum dots (QDs) are subject of intense research due to their exceptional properties as both classical[1] and quantum light sources.[2-4] Here[5,6] we present perovskite-type (ABO_3) binary nanocrystal superlattices, created via the shape-directed co-assembly of steric-stabilized, highly luminescent cubic $CsPbBr_3$ nanocrystals (which occupy the B and/or O lattice sites), assembled in combination with spherical Fe_3O_4 or $NaGdF_4$ nanocrystals (A sites). These ABO_3 superlattices, as well as the binary NaCl and AlB_2 superlattice structures that we demonstrated, exhibit a high degree of orientational ordering of the $CsPbBr_3$ nanocubes which preserve their high oscillator strength and long exciton coherence time in the assembly. Such superlattices exhibit superfluorescence—a collective emission that results in a burst of photons with ultrafast radiative decay (22 picoseconds) that could be tailored, by structural engineering of the nanoparticle assembly, for use in ultrabright (quantum) light sources. Our work paves the way for further exploration of complex, ordered and functionally useful perovskite mesostructures.

References

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