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Self-assembly of perovskite nanoplates in colloidal suspensions†



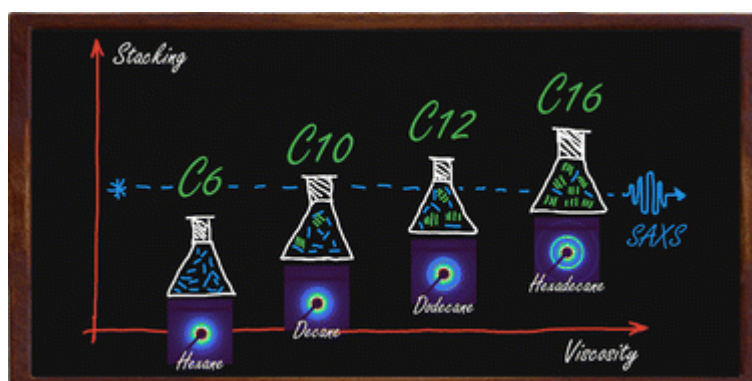
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Abstract

In recent years, perovskite nanocrystal superlattices have been reported with collective optical phenomena, offering a promising platform for both fundamental science studies and device engineering. In this same avenue, superlattices of perovskite nanoplates can be easily prepared on different substrates, and they too present an ensemble optical response. However, the self-assembly and optical properties of these aggregates in solvents have not been reported to date. Here, we report on the conditions for this self-assembly to occur and show a simple strategy to induce the formation of these nanoplate stacks in suspension in different organic solvents. We combined wide- and small-angle X-ray scattering and scanning transmission electron microscopy to evaluate CsPbBr₃ and CsPbI₃ perovskite nanoplates with different thickness distributions. We observed the formation of these stacks by changing the concentration of nanoplates and the viscosity of the colloidal suspensions, without the need for antisolvent addition. We found that, in hexane, the concentration for the formation of the stacks is rather high and approximately 80 mg mL⁻¹. In contrast, in decane, dodecane, and hexadecane, we observe a much easier self-assembly of the nanoplates, presenting a clear correlation between the degree of aggregation and viscosity. We, then, discuss the impact of the self-assembly of perovskite nanoplates on Förster resonant energy transfer. Our predictions suggest an energy transfer efficiency

higher than 50% for all the donor–acceptor systems evaluated. In particular, we demonstrate how the aggregation of these particles in hexadecane induces FRET for CsPbBr₃ nanowires. For the $n = 2$ nanowires (donor) to the $n = 3$ nanowires (acceptor), the FRET rate was found to be 4.1 ns⁻¹, with an efficiency of 56%, in agreement with our own predictions.



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