Ultrathin PbS Sheets by Two-Dimensional Oriented Attachment

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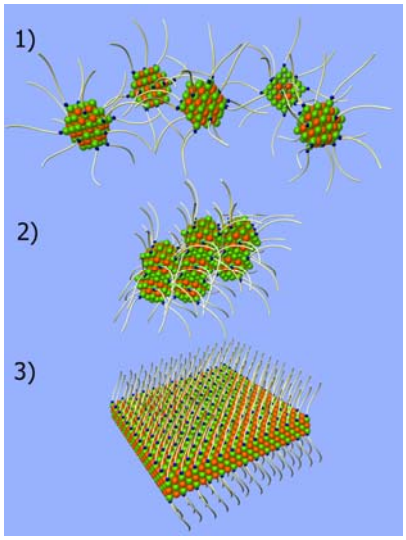
Nanostructured materials offer a huge range of possibilities for the development of new devices with fascinating optical, magnetic, or electronic properties. The synthesis of colloidal semiconductor nanoparticles has been vastly improved in the last decades. In this work, a novel procedure developed to organize dot-like semiconducting nanocrystals into 2D nano-sheets will be presented. By means of this procedure the nanoparticles initially covered by randomly oriented organic molecules (see illustration on the right) assemble like “lego” bricks to form small aggregates that evolve into crystalline sheets. During this process, the organic molecules densely pack and organize on the surface of the new crystal. This ordered arrangement of the organic molecules allows the formation of these two dimensional crystals.

The work shows the formation mechanism of two-dimensional crystalline structures, based on the interaction among nanocrystals with defined orientations and the self-assembly and packing of the organic molecules on their surface. The results have special relevance to understand and control the shape of colloidal nanostructures, key for the generation of advanced functional materials at the nanoscale. These ordered 2D structures with just 2 nm thicknesses have been integrated in photodetectors. The results may be relevant to generate more efficient devices.

(1) Constanze Schliehe et al. S*cience*, 329, 5991, **2010,** 550-553



Scheme of the fusion of nanocrystals to form 2D crystals in three steps: Initially, nanocrystals stabilized by organic molecules in solution (1) form small aggregates by fusing in certain crystallographic directions (2). These aggregates evolve to form the crystalline sheets (3). During this process, the organic molecules self-assemble and densely pack on both sides of the crystal.