IST AUSTRIA
Institute of Science and Technology

Physical Sciences Seminar

Colloidal quantum dot superlattices: physical chemistry, solid state physics and applied properties

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Host: Maria Ibáñez

Bottom-up created macroscopic materials with designer properties have been and will remain in the focus of researchers for energy applications for their prospects in overcoming efficiency, cost or durability limits set by conventional bulk and simpler soft materials. Controlling the properties of solids is mostly realized through adjusting the chemical composition and/or creating favorable structural features. In conventional solids, mixing two or more materials can either lead to homogeneous atomic mixing, or multiple phases mixed at larger length-scales with uncontrollable distribution. Bottom-up fabricated solids based on colloidal quantum dots (CQDs) fill the gap between the two regimes: structures with long-range nanoscale periodicity and controlled composition can be achieved. Moreover, the small (few nm) size leads to significant faceting, setting the interaction dependent on the individual CQD orientation, and creating coexisting single crystal-like atomic and a superlattice structures. Exploiting it one could create extended, periodic arrays with multilevel ordering, and control the geometry of the superlattice by the particle shape, surface and assembly conditions. In the first part of the talk, I discuss the considerations for the formation of CQD superlattices. Understanding the physicochemical phenomena that take place during assembly is of importance for developing highly ordered materials over macroscopic length scales. Using grazing incidence small angle X-ray scattering (GISAXS), the fluid and particle dynamics which lead to the final structures can be tracked, bringing us one step closer to the ideal ordered, homogeneous arrays. In the second part of the talk, I give an overview how the macroscopic optical and electronic properties of CQD assemblies can be fine-tuned by exploiting the presence of quantum confinement and the large surface-to-volume ratio, all by simple, chemical methods. The overall effect is always a combination of doping, electronic coupling or electronic structure engineering, which can be studied and distinguished using a combination of techniques, contributing to the understanding of chemistry at the nanoscale.

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IST Austria Campus Heinzel Seminar Room / Office Bldg West (I21.EG.101)

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