Colloidal Quantum Dots: from their Discovery to Applications

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Colloidal quantum dots (QDs) are tiny semiconductor crystallites (nanocrystals), on the order of 2-20 nanometers, whose electronic and optical properties are governed by their size and shape. Chemical synthesis routes had yielded unprecedented variety of nanocrystal compositions and morphologies. The practical utility of these materials is generally determined by the state of QD surfaces and the ability to electronically couple between each other. Their prospective applications include light-emitting diodes, LCD displays, solid-state lighting and, on the longer-term, quantum light sources. Their colloidal state enables facile solution processing for integration into thin-film and other devices.

In this talk, we will cover the brief history of colloidal QDs, the state-of-the art in their synthesis and surface functionalization, self-assembly and processing, as well as commercial and upcoming applications. The specific examples will include our own research as well as prominent examples from the literature. In particular, we will discuss compound II-VI, III-V and IV-VI semiconductor QDs, as well as emerging class of lead halide perovskite QDs. The letter features unprecedented defect-tolerance, enabling their facile synthesis and robust processing.