CORE SHELL SEMICONDUCTOR NANOCRYSTALS

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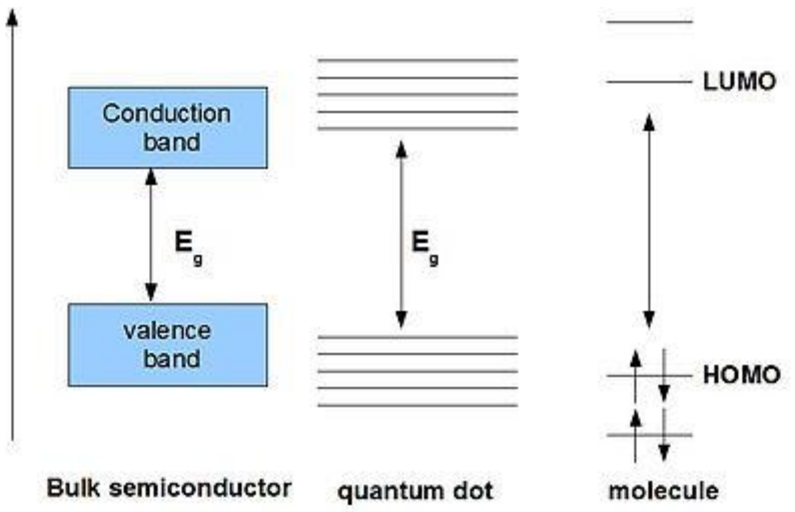
Core–shell semiconducting nanocrystals are a class of materials which have properties intermediate between those of small, individual molecules and those of bulk, crystalline semiconductors. They are unique because of their easily modular properties, which are a result of their size. These nanocrystals are composed of a quantum dot semiconducting core material and a shell of a distinct semiconducting material. The core and the shell are typically composed of type 2–4, 4–6, and 3–5 semiconductors, with configurations such as (CdS/ZnS), (CdSe/ZnS), (CdSe/CdS), and (InAs/CdSe) (typical notation is: core/shell) Organically passivated quantum dots have low fluorescence quantum yield due to surface related trap states. Their address this problem because the shell increases quantum yield by passivating the surface trap states. In addition, the shell provides protection against environmental changes, photo-oxidative degradation, and provides another route for modularity. Precise control of the size, shape, and composition of both the core and the shell enable the emission wavelength to be tuned over a wider range of wavelengths than with either individual semiconductor. These materials have found applications in biological systems and optics. Colloidal semiconductor nanocrystals, which are also called quantum dots , consist of (1–10 nm) diameter semiconductor nanoparticles that have organic ligands bound to their surface. These nanomaterials have found applications in nanoscale photonic, photovoltaic, and light-emitting diode devices due to their size-dependent optical and electronic properties. Quantum dots are popular alternatives to organic dyes as fluorescent labels for biological imaging and sensing due to their small size, tuneable emission, and photostability. The main challenge in using organic ligands for quantum dot surface trap passivation is the difficulty in simultaneously passivating both anionic and cationic surface traps. Steric hindrance between bulky organic ligands results in incomplete surface coverage and unpassivated dangling orbitals. Growing epitaxial inorganic semiconductor shells over quantum dots inhibits photo-oxidation and enables passivation of both anionic and cationic surface trap states. As photogenerated charge carriers are less likely to be trapped, the probability for excitons to decay through the radiative pathway increases. (CdSe/CdS) and (ZnSe/CdSe) nanocrystals have been synthesized that exhibit 85% and(80–90%) quantum yield, respectively.

Core–shell semiconductor nanocrystal architecture was initially investigated in the 1980s, followed by a surge of publications on synthetic methods the 1990s.



The electronic structure of QUANTUM,MOLECULE AND SEMICON.

One of the most important properties of core–shell semiconducting nanocrystals is that their cores, which is important in their biomedical and optical applications. The shells are highly modular, and thus the bulk properties, such as solubility and activity of the them can be changed.

REFERENCES

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