Science of Advanced Materials
Vol. 1, 1–8, 2009

Controlled Growth of CdS Quantum Dots

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The role of 3-mercaptopropionic acid as a surface anchoring group and the reaction temperature for the controlled growth of CdS crystals was investigated from a one-step aqueous synthesis carried out both at room temperature and using a hydrothermal route. The thiol group of 3-mercaptopropionic acid forms a relatively strong bond with the cadmium atoms found at the particle surface reducing the crystal growth rate. This leads to the formation of monodisperse crystals of about 2 nm diameter. For a low thermal activation, at room temperature, for instance, the crystal growth is mainly determined by the nucleation process without evidence of a large contribution from Ostwald ripening. When the thermal activation competes with the binding energy for the thiol group to the cadmium atom, the surface shell becomes unstable and the crystals growth involves the coarsening mechanism. Under hydrothermal conditions the radius (r) for the obtained crystals follows a linear dependence for r^3 versus t (reaction time). The crystal growing process is halted when the colloidal suspension is cooled. An appropriate control for the time and temperature of heating allows crystals of a tailored size to be obtained. The obtained colloidal suspensions of CdS nanocrystals were characterized from optical absorption, high-resolution transmission electron microscopy, and photoluminescence data.