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Temperature dependence of the band gap of CdTe–CdS core–shell quantum dots

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Quantum dots (QDs) have attracted increasing interest for their potential use in lasers, solid-state lighting, electronics, photovoltaics, photocatalysis, thermoelectric and biomedical fields. Cyclic voltammetry measurements of QDs give information on the absolute energies of the band gap, valence and conduction bands (from the oxidation and reduction potential values). In this thesis the temperature dependence of the electronic band gap of CdTe–CdS core–shell semiconductor nanocrystals stabilized by thioglycolic acid of different diameter was carefully measured. The cyclic voltammograms were obtained by scanning the potentials from -2 to 2 V at scan rates of 0.1, 0.2, 0.5, 1 and 2 V/s. Measurements were carried out in the range starting from room temperature to 55°C.

It was found that the difference between the potentials of cathodic and anodic peaks in cyclic voltammograms corresponds to the band gap (Eg) which is consistent with spectroscopic data. Furthermore, it was found that the energy band gap tends to decrease as the temperature increases. A reason for such behavior may be related to the increase of interatomic spacing when the amplitude of the atomic vibrations increases due to the increased thermal energy.

A cyclic voltammetry method was applied to determine band structure of the particles for instance the band gap (Eg), conduction band edge and valence band edge as a function of quantum dot size and temperature-dependent investigations of CdTe QDs electrochemical properties.