Muonium in nano-crystalline II-VI semiconductors

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Colloidal semiconductor nanocrystals are a subject of quantum confinement that makes their optical and electrical properties strongly size dependent. The fundamental question is whether properties of nanocrystals can be further engineered by doping and whether characteristics of implanted impurities are also affected by the particle size. This would open the gate to electronic functional nanocrystal materials. It was suggested that hydrogen incorporation may enhance electron transport in ZnO nanocrystal assemblies [1,2].

μSR offers a unique opportunity to study a hydrogen-like state in semiconductors, as has been done in bulk II-VI semiconductors [3,4].

We have studied formation of muonium states in capped nano-crystals of ZnO, CdTe and CdSe with various size distributions. We used transverse field in the high-field limit for low hyperfine-interaction states, as well as zero-field and longitudinal-field repolarisation probes. The results suggest the formation of muonium states at the surface of the ZnO nano-crystals. In CdTe and CdSe nanocrystals there is evidence of formation of muonium states in capping materials. However, in nc-CdTe we also observe size dependence suggesting a possibility of formation of a confined hydrogen-like muonium state *inside* the nanocrystals.

In this contribution, we present the results of the experiments and discuss the possible interpretations.

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