סמינר כימיה פיסיקלית ואנליטית

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Maya Isarov

Schulich Faculty of Chemistry and
Grand Technion Energy Program, Technion

נושא:

OPTICAL PROPERTIES OF ALL-INORGANIC METAL-HALIDE PEROVSKITES AND METAL CHALCOGENIDES COLLOIDAL NANO-CRYSTALS

This research was conducted under the supervision of Prof. Efrat Lifshitz

ההרצאה תתקיים בחדר הסמינרים הפקולטי

Optical Properties of All-Inorganic Metal-Halide Perovskites and Metal Chalcogenides Colloidal Nano-Crystals

Abstract:

Colloidal nanocrystals (NCs) are of considerable interest due to their size-dependent optical and electronic properties, which allow their implementation in photovoltaic cells, light-emitting diodes, photo-detectors and more. Along with the development of the synthesis procedures, numerous investigations have explored the optical and electronic properties of different NCs, involving the study of exciton emission. The current work focuses on two types of NCs: CsPbBr3 perovskite and CdSe/CdS with core/alloyed-shell.

We investigated for the first time the interplay of Rashba and band-edge excitonic effects in CsPbBr3 single NC, in particular showed an evidence for the Rashba effect in the excitonic magneto-photoluminescence spectra of CsPbBr3 at cryogenic temperature. Using a home-built confocal microscope we recorded the band-edge excitonic transitions, by measuring the linearly- and circularly-polarized photoluminescence (PL) of a single CsPbBr3 NC under an applied magnetic field, up to 8T. The experiments resolved discrete narrow excitonic transitions with an energy splitting that increases nonlinearly with the magnetic field strength. The nonlinearity in the exciton band splitting observed in the experiment is supported by our theoretical calculations, suggesting a crossover between the Rashba effect at low magnetic fields to a Zeeman effect at higher fields. The unusual magneto-optical properties shown in this work underscore the importance of the Rashba effect in the implementation of such perovskite materials in various optical and spin-based devices.

In addition, the influence of the low temperature coating and annealing processes on the optical properties of CdSe/CdS NCs with 3 monolayer (ML) and 6ML shells, were investigated by comparative experimental studies of NCs ensemble, using temperature dependent optical spectroscopy. We showed that low temperature coating and annealing led to enhanced PL quantum yield, due to reduction of lattice strain, suppression of the number of defects at the CdSe core surface and formation of alloy at the CdSe/CdS interface.

chfruma@techunix.technion.ac.il
www.schulich.technion.ac.il
T. + 972 4 829 3654
F. + 972 4 829 3499
Technion City
Haifa 32000 Israel
קרית הטכניון
חיפה 32000