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ΤΜΗΜΑ ΦΥΣΙΚΗΣ

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στην παρουσίαση της Διδακτορικής Διατριβής του Πάρι Παπαγιώργη

"SPECTROSCOPIC STUDIES OF NANOCRYSTAL SOLIDS FUNCTIONALIZED FOR OPTOELECTRONIC APPLICATIONS"

Spectroscopic studies on two promising for optoelectronics, semiconducting colloidal nanocrystal (CNCs) systems are reported. The first and greater part of the work is concentrated on PbS CNCs, owing to the maturity of the material chemistry and the prospect for a PbS-based infrared light sensing technology. Despite some early device successes, the high promises were not met at the time that this thesis was initiated, mainly due to the poor solid state transport properties of PbS CNCs. Dot-to-dot electronic communication is inhibited by the typically long insulating organic ligands used to decorate their surface. The presence of such ligands is critical as they provide efficient passivation of the surface and colloidal stability to CNCs. To circumvent the problem various strategies were explored. In the present work, we focused our photophysical studies on the investigation of functionalized PbS CNC solids produced via three promising approaches based on: (i) mixing the CNCs with conductive polymers, (ii) ligand exchange processes that replace the insulating organic with conductive inorganic moieties and (iii) chemical approaches applied during or post-synthetically to produce substitutional electronic material doping. The last part of the work is related to studies of new CNCs based on the family of lead halide perovskites. Perovskites emerged the last years as semiconducting materials with extraordinaire optoelectronic properties. Nanoscale analogues of perovskites and in particular perovskite CNCs exhibit even more impressive properties, especially related to photonics. Herein work on two interesting aspects of the photophysics of recently synthesized robust formamidinium lead iodide ($FAPbI_3$) CNCs, are reported. Spectroscopic evidence of a significant slowdown of the hot carrier cooling time and highly efficient optical amplification are discussed. The work demonstrates the high potential of such nanomaterials for novel applications in hot solar cells and high performance lasers

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