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Hybrid nanostructure of plasmonic nanoparticle and semiconductor quantum dot mono-layers on surface-functionalized quartz plate and PMMA spacer

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Mono-layers of plasmonic nanoparticles and semiconductor nanocrystals on surface-functionalized quartz plate and poly(methyl methacrylate) (PMMA) were prepared for photonic applications. The quartz plate was hydroxylated using oxygen plasma and silanized in ethanol containing 1 wt. % 3-aminopropyltriethoxysilane (APTES) to form amino functional group. The amino-functionalized surface on the quartz plate was stabilized by a heat treatment. Au colloidal nanoparticles were deposited on the amino-functionalized quartz plate, rinsed with water, and dried with Ar gas. The PMMA was casted as a spacer between mono-layers of Au nanoparticles and CdSe/ZnS nanocrystals. The thickness of PMMA was controlled by oxygen plasma etching by breaking the polymer hydrocarbon, which determined the coupling distance between excitons and plasmons. The hydrophobic surface of PMMA was transformed to hydrophilic condition with casein in phosphate buffered saline solution. Carboxylated CdSe/ZnS colloidal nanocrystals were deposited on the PMMA. Finally, the surface was casted with PMMA again to reserve the optical properties of plasmon-coupled semiconductor nanocrystals. The absorption peak of Au colloidal nanoparticles with diameter of ~32 nm was ~531 nm, and absorption and fluorescence spectral peaks of CdSe/ZnS were ~608 nm and ~621 nm, respectively. This spectral condition provided a near coherent spectral coupling of excitons at the bandedge of plasmons. This presentation will also include fluorescence enhancement, polarization, and lifetime decays of semiconductor nanocrystals in the vicinity of plasmonic Au nanoparticles with near coherent spectral coupling condition. Acknowledgement: This work was supported by NSF HRD-1137747 and ARO W911NF-11-1-0177(HU), NIH R01EB12003 and 5R21CA14897 (Z.G.) (UNT), and NSF EEC-0647452 (RU).

Biography

Roopchan Ramdon, is a Masters Candidate in the Advanced Center for Laser and Science Spectroscopy (ACLaSS), in the Department of Physics at Hampton University. He has successfully completed an oral defense for his M.S. degree. His research results have been published in three journal articles; Physics Review Letters, Physics Letter B, and Journal of Nanomaterials; and presented three conference abstracts. His expertise is in the optical nanomaterials development and characterization. He will continue his Ph.D. studies in the ACLaSS at Hampton University.

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