1-1-2016

The Impact of Metallic Nanoparticles on Lifetime of Semiconductor Quantum Dots

Seyed Sadeghi
University of Alabama in Huntsville

Title: Impact of metallic nanoparticles on lifetime of semiconductor quantum dots

Research Mentor Dr. Seyed Sadeghi

Email: ss0013@uah.edu, Tel: 256-824-2490**,** Optics Building rm#222

Project Summary

Quantum dot semiconductors are efficient emitters with many applications, ranging from optical devices to medical imaging, sensors, quantum information, etc. The efficiencies of quantum dots can increase further once they are put in the vicinity of metallic nanoparticles. In my laboratory (Nanophotonics and Quantum Devices group) in physics department at UAH we have gained significant experience in regard to enhancement of emission of quantum dots using such nanoparticles. The goal of this undergraduate research is to provide an opportunity to an undergraduate student to study how such metallic nanoparticles can change the lifetime of quantum dots. This makes the interested student familiar with one of the most useful techniques that is being used in many different fields from biology to engineering. This technique allows us to understand, for example, how cells interact with environment, carriers move in a laser, nanoparticles interact with each, and many other applications.

For this RCEU project the student and I will work together to set up an optical system in my one of my labs. This system will be consisted of a picosecond pulse laser, single-photon detector, a time-correlated single-photon counter, and several other optical components to measure the emission of colloidal quantum dots. The quantum dots will be spin coated on glass substrates or on metallic nanoparticle embedded in silica. The quantum dots will be acquired from NN labs or Ocean Nanotech. The metallic nanoparticles samples will be fabricated by my graduate students in my group. The undergraduate student needs to learn about the concept of single-photon counting and its electronics. He/she will have the chance to use this technique for imaging of applications, if time allows.

This research will have large impact on our research, and other students can benefit from it significantly. While carrying out this research, the undergraduate student will become familiar with optics, time-resolved measurement, spectroscopy, and nanoscience. Therefore, it may have some impact on his/her future plan of education.

Student Duties

The student will be expected to setup and perform experiments on spectrally- and time-resolved emission of quantum dots in the presence and absence of metallic nanoparticles. The process of setting up the experiments will expose him/her to important optical equipment including lasers, monochrometers, spectrometers, ultrahigh photodetectors, etc. that he/she would not normally deal with in a classroom setting. He/she will also be exposed to frontier of research in plasmonics and optics. He/she will be expected to produce experimental results that have the possibility of being included in papers. He/she will also be expected to create report on weekly basis summarizing the major findings of his/her research and to present his/her findings at the end of the summer. The data collected need to be saved properly in the Nanophotonic Lab.

Mentor Supervision and Interaction

I will have a fairly direct interaction with the student, with daily meetings discussing goals for the day followed by various progress checks throughout the day. The project will rely on regular collaboration to troubleshoot experimental issues as well as to discuss the results of the experiments and their implications, which will constitute the educational portion of the program. The interested undergraduate student will also be collaborating with my graduate students working on related experiments.