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Biochemical Sensors Based on Metallic Nanoparticles

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Title: Biochemical sensors based on metallic nanoparticles

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Previously participated in the RCEU.

Project Summary

Properties of metallic nanoparticles (plasmonic effects) are ideal for investigation of biological processes and sensing of biomolecules. In my laboratory (Nanophotonics and Quantum Devices Lab) in the physics department at UAH we have significant experience in regard to fabrication and spectroscopy of metallic nanoparticles. We have also state-of-art systems for imaging of such nanoparticles by themselves and inside various environments. The goal of this undergraduate research is to provide an opportunity to an undergraduate student to study how arrays of metallic nanoparticles can be used as biochemical sensors. This will done by introduction of chemical materials to the arrays and functionalization of gold metallic nanoparticles with certain biological molecules that can act as receptors for biomolecule targets.

For this RCEU project the student and I will work together to set up an optical system in my one of my labs. We will study how chemical and biological materials influence optics of arrays of metallic nanoparticles. We use study how these materials can change interaction of light with the arrays. The outcomes will be used to find ways to detect certain chemical and biological molecules. The undergraduate student needs learn spectroscopy as tool. No major optical set up is needed. He/she will have the chance to use this technique for imaging applications, if time allows. Biology background is a plus for this project.

Student Prerequisites

Minimum GPA: 3.5
Completed second year of college by summer of 2022
Passed some laboratory courses (physics, chemistry, or biology)

Student Duties

The student will be expected to:

1. find a protocol for biological functionalization of metal surfaces
2. conjugate biologically-tagged semiconductor quantum dots with metal surfaces and metallic nanoparticles
3. measure emission of quantum dots
4. set up limited amount of optics
5. document the data and report

The process of setting up the experiments will expose the undergraduate student to important optical equipment including lasers, monochrometers, spectrometers, ultrahigh sensitive

photodetectors, etc. He/she will also be exposed to frontier of research in plasmonics and optics. The student will 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 must 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.