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Detection of Biological Molecules using Metallic Nanoparticles

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Title: Detection of biological molecules using metallic nanoparticles

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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 such metallic nanoparticles can be used as biological sensors. This will done by functionalizing gold metallic nanoparticles with biological molecules (receptors) to detect a particular type of target biological molecules.

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 use semiconductor quantum dots that are already tagged with streptavidin and find out how we can functionalize metallic nanoparticles with biotin, so that they are conjugated together. We use spectroscopy techniques to find out how emission of the quantum dots can be used to identify the conjugation process and, therefore, biological sensing is carried out. 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 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.