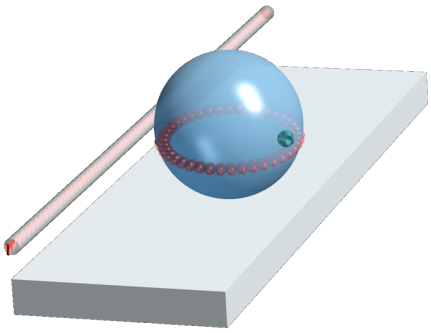
Master Thesis

Research-related and Interesting

Ultra-Sensitive Biosensor Based on Adding a Quantum Dot Layer to a Silica Spherical Microresonator



Optical biosensors due to their sensitivity, specificity, small size, as well as cost effectiveness are an attractive form of sensing, already established in biological studies and diagnosis. Optical microresonators capable of sustaining whispering gallery modes are a subcategory of optical biosensors, which show high sensitivity to their micro environment and have the potential of detecting down to one single virus. In this regard, optical microresonators can provide a platform for fundamental life studies as well as early-stage diagnostics.

As a part of a DFG research project aiming at developing an untra-sensitive biosensor for early stage cancer diagnosis, we intend to improve the sensitivity of spherical optical microresonators through adding a quantum dot doped layer to the microresonator. The quantum dot doped layer shall be designed to show an excitonic resonance at the corresponding whispering gallery mode of the microresonator. The designed layer will be then added to the microresonator in order to achieve a photonic-excitonic coupling and correspondingly improve the sensitivity of the underlying optical biosensor. The sensitivity will then be evaluated through embedding a dielectric nanoparticle, mimicking the characteristics of an exosome, to the vicinity of the microresonator.

The current master project will deal with the design of the quantum dot doped layer, using the finite element based simulation software COMSOL Multiphysics. Afterwards, and based on the effective medium theory, an effective refractive index will be assigned to the quantum dot doped layer. Through this work, the student will gain knowledge about modeling of electromagnetic systems, the field of bioelectromagnetics, as well as nano optics.

Got curious? simply contact us for an informal meeting discussing the topic or send a thesis request per email to us.

Requirements:	Knowledge of electromagnetic field theory, interest in modeling and simulation of electromagnetic systems and bioelectromagnetics, knowledge of numerical simulation is preferred.
Character of the project:	40% Theory / 60% Simulation
We offer:	An interesting master project at the edge of science in a friendly research environment.
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