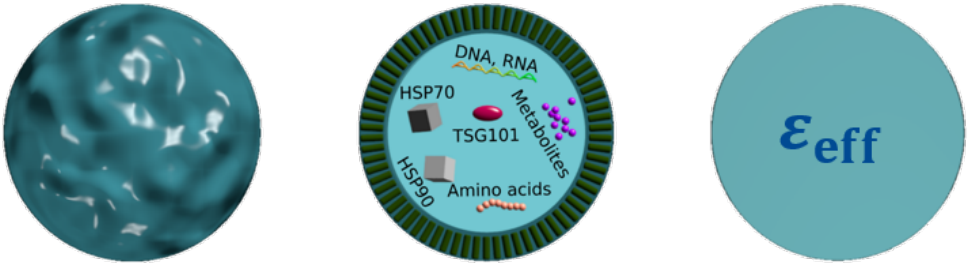
Master Thesis

Research-related and Interesting

Determining the Effective Refractive Index of Exosomes Based on the Effective Medium Theory



Exosomes are extracellular vesicles, with contents resembling their parental cell. Due to such resemblance together with the fact that they can be acquired from bodily liquids, exosomes are desirable agents for an early stage, non-invasive diagnosis in various diseases such as cancer. Hence, exosome characterization is became an active field of research, aiming at developing exosome based biosensors. However, detecting exosome's internal contents mainly requires biochemical agents as label, which results in time-consuming, costly sensing methods. Accordingly, in order to develop an label-free exosome based sensing method, the internal contents of a given exosome should be translated into an external characteristics such as an effective refractive index. Effective medium theories, either based on classical mixing formulas such as Maxwell-Garnett approach or based on full-wave simulations determining the mean fields, are established techniques for calculating the effective refractive index of a given multi-phase medium, and can be implemented to determine the effective refractive index of exosomes.

As a part of a DFG research project aiming at developing an ultra-sensitive biosensor for early stage, non-invasive, label-free cancer diagnosis, we intend to use exosomes as the detection agents. Correspondingly, a detailed exosome characterization and classification is required in order to distinguish among cancerous versus healthy exosomes. As exosomes have various contents with inhomogeneous shapes, full-wave simulations based on the mean field theory should be implemented to determine the inhomogeneous tensorial representation of the effective refractive index of the exosome. The distinction among cancerous versus healthy exosomes lies in their protein content, which then will be visible in the calculated tensorial effective refractive index, and will be used to classify exosomes based on their health state.

The current master project will deal with a detail characterization of breast cancer exosomes, based on both classical mixing formulas such as Maxwell-Garnett approach and the Bruggeman mixing equation as well as full-wave simulation of the exosome. The inhomogeneous effective refractive index of underlying exosomes should be extracted and compared for healthy and cancerous exosomes.

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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