Antenna-Assisted Fluorescence Microscopy

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Noble metal nanostructures can be employed as optical antennas to boost light matter interaction. In analogy to radiofrequency antennas these optical antennas convert the energy of free propagating light into localized energy, and thus are able to enhance and confine incident laser radiation to an area much smaller than the diffraction limit of light. Advances in the development of optical antennas have stimulated their use for optical imaging on the nanometer scale and in biosensing applications. Recently, spherical Au nanoparticles have been employed as optical antennas, and their influence on the fluorescence emission rate of a nearby quantum emitter has been studied [1,2].

We use spherical gold nanoparticles as building blocks for the fabrication of optical antennas and apply these optical antennas for nanoscale fluorescence imaging of individual biomolecules, such as membrane proteins, receptors, and lipids in cellular membranes. Raster-scanning a fluorescently labeled sample in close proximity underneath the optical antenna, the emitted fluorescence rate is recorded pixel by pixel. Thereby the detected signal comprises both near-field and far-field contributions due to the direct laser-illumination of the optical antenna. By means of this technique we are able to identify, localize and address individual membrane proteins in their natural environment [3], and thus, can provide insights into the local chemical and structural organization of individual membrane entities, which is of key importance for understanding the diversity of biological processes associated with specific proteins.

In this talk, I will discuss the fabrication and optical properties of spherical Au nanoparticle antennas as an example for an optical antenna, the technical principles of antenna-assisted fluorescence microscopy and demonstrate its potential for mapping the spatial distribution of specific membrane proteins by means of simultaneous colocalization in their natural environment [4].

References:

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