Investigation of fluorescence emission enhancement in the vicinity of nanostructured metallic surface by FDTD method and experimental measurements

Fluorescence, or generally luminescence, is a widely exploited phenomenon nowadays, in applications ranging from biomedical imaging and bio(chemical) assays to lasers, lighting devices, or displays in mobile devices. Within this thesis we aim to provide a reliable approach of calculating both the contributions related to the enhancement of excitation due to plasmon-amplified electromagnetic fields as well as the enhancement of the emission by coupling of the emitter to surface plasmons at the emission frequency via the FDTD method. Thus a simple kind of structure (core-shell Au nanosphere) as well as a more complex one (2D monoarray of polystyrene microspheres covered by a thin Au film) were characterized both experimentally and theoretically. A good agreement was obtained via both approaches, which enables us to state that the FDTD method is reliable when having to calculate the metal enhancement factors (MEF) of metal nanostructures. This can help out researchers and eliminate the some of the uncertainties regarding first of all the possibility of the structures to enhance the fluorescence signals as well as the parameters that are usually optimized (e.g. dielectric spacer).

Key words: metallic nanostructures, FDTD, fluorescence, numeric simulations, quantum yield, optics, electromagnetics

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