Title: Optical Responses of Biomolecules on Regular Metal Plasmonic Nanostructures

Author: Martin Šubr

Department: Institute of Physics of Charles University

Supervisor of the doctoral thesis: prof. RNDr. Marek Procházka, Dr., Institute of Physics of Charles University

Abstract: Adsorption of molecules on metal plasmonic nanostructures leads to significant enhancement of many optical processes, such as Raman scattering (surface-enhanced Raman scattering – SERS) or fluorescence (surface-enhanced fluorescence – SEF). Two groups of substrates were tested within this thesis: (i) Silver nanorods prepared by oblique angle vapor deposition, and (ii) silver and gold nanoislands growing on magnetron-sputtered polytetrafluoroethylene film. Step-by-step optimization process was performed on the nanoislands in order to obtain optimum SERS sensitivity and reproducibility. Detailed SERS intensity profiles were obtained using gradient nanostructures with the localized surface plasmon resonance (LSPR) condition varying across the sample and three different excitation wavelengths. It was also found that spectral position and height of the LSPR band can be controlled simultaneously using mixed gold/silver nanoislands. Detailed investigation of polarization- and angular- dependences of anisotropic silver nanorods was performed in the 90°-scattering geometry in which two out of three angles determining the nanorod spatial orientation were varied simultaneously. A theoretical model for elucidation of the anisotropic SERS properties based on ellipsometric characteristics of the substrate is presented. Silver nanoislands were used for SEF study of riboflavin on PTFE spacer of various thicknesses. Very good correspondence between SEF enhancement and fluorophore lifetime shortening was found.

Keywords: Surface-enhanced Raman scattering, biomolecules, surface-enhanced fluorescence, nanoislands, nanorods