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Title of the doctoral dissertation: **Influence of morphology on the plasmonic properties of chemically synthesized silver nanowires: experimental and numerical studies**

Abstract

The main aim of this thesis was to obtain silver nanowires of various morphologies using chemical synthesis. It then aimed to demonstrate the influence of silver nanowire morphology on their optical properties. These properties included the enhancement of fluorescence and the propagation length of surface plasmon polaritons. Fluorescence microscopy methods were used for this analysis, with a peridinin-chlorophyll-protein complex as the fluorophore. Additionally, numerical methods were applied to describe the interactions of electromagnetic waves with matter.

The first chapter serves as a theoretical introduction to this thesis. It discusses methods for synthesising nanoparticles (with particular emphasis on silver nanowires), physical phenomena occurring during the growth of nanocrystals, as well as chemical modification of nanoparticle surfaces. The next part describes the interaction of nanoparticles and fluorophores with light, a comprehension of which is crucial for understanding interactions between nanoparticles and fluorophores. The summary includes a literature review containing key research findings regarding fluorescence enhancement by nanoparticles and surface plasmon polariton (SPP) damping. These results focus on the fluorescence enhancement of various types of molecules by AgNWs and characterisation of surface plasmon polariton modes depending on morphology.

The second chapter describes the materials and experimental techniques used. It includes a description of the main experimental techniques used in the study: wide-field fluorescence microscopy, confocal fluorescence microscopy, time-resolved spectroscopy, scanning electron microscopy, spectrofluorimetry, and UV-Vis spectroscopy. Schemes of the optical microscopes used along with technical details are presented. The chapter concludes with descriptions of numerical methods - finite element simulations used to simulate the interaction of silver nanowires with light implemented in the COMSOL software.

The third chapter presents the results of the study. The hydrothermal method for synthesising silver nanowires with different morphologies is described first. The optical properties of silver nanowires were investigated in two configurations: 1) polymer matrix with photoactive PCP protein and 2) PCP monolayer covering the nanowires. Both experimental and numerical techniques were used to investigate fluorescence enhancement by silver nanowires and damping of surface plasmon polariton propagation. The last part demonstrates the method of coating the tip of a silver nanowire with PCP and proves that nanowires obtained through the synthesis described in this work can be used to excite molecules located 100 µm away from the laser focused on the nanowire end. The final chapter of the thesis summarizes the results.