ABSTRACT

LSPR- and SERS-based Plasmonic Sensors

There is significant interest in the development of plasmonic nanostructures for the detection of chemicals or biomarkers based on Localized Surface Plasmon Resonance (LSPR). The large electric-field enhancement due to the excitation of LSPR or SPR also enables surface-enhanced Raman scattering (SERS), which is used for specific and sensitive detection of chemicals and biological molecules of interest. This thesis details the research work carried out in the development of plasmonic nanostructures and nanoparticles for LSPR- and SERS-based applications.

The design and numerical simulations of a nanostructure geometry consisting of arrays of nanocrosses interspaced between triangular bowties. Various geometrical parameters were varied, and their effect studied. The geometry was suitably tuned to maximize bulk and localized sensing performance, and for varying operating wavelengths. High bulk sensitivity of 1753 nm/RIU and localized sensitivity of 70 nm/nm were achieved.

A fabrication method for the formation of gold nanoparticles was studied. Process parameters were varied to obtain nanoparticles of suitable dimensions, and subsequently tested for their bulk and localized sensing performance.

The fabrication method for a large-area nanostructured gold surface was developed and studied for variation in the process parameters. The substrates were tested using a SERS active molecule, and subsequently used for the detection of pesticides.

The growth of silver nanowires was performed on different substrates and their performance compared. The substrates were assessed via a SERS active molecule and used for the detection of nucleobases. Very low concentration of pMBA could be detected using the SERS substrates.