Short Abstract of the Thesis

The thesis entitled, "Nanobiosensors Targeting Affordable Detection of Biomarkers and Pathogens: Experimental and Computational Outlook" work on innovative nanoplasmonic methodologies for non-invasive, selective point-of-care diagnostics and disease transmission modelling. The first technical chapter explores a non-invasive method for cervical cancer identification utilizing a urinary protein, Protein Phosphatase-1-Gamma-2 (PP1ϒ2), as a potential biomarker. A gold nanoparticle-based immunosensing method was developed, and a 3D-printed point-of-care device prototype was fabricated for real time screening of the disease using urine sample of the patient. The second technical chapter work on the selectivity of Escherichia coli (EC) detection for the diagnosis of urinary tract infections (UTIs) using plasmon-enhanced gold nanotwins (Au NTs). Herein, gold nanotwin immobilized with aptamer specific to EC was imbedded on glass substrates to prepare a plasmonic transparent substrate for UTI detection. A portable device prototype was also fabricated and tested for the detection of EC as a measure of UTI detection in urine sample. The third technical chapter of the thesis delves into the enzymatic detection of total cholesterol and triglycerides with surface-enhanced Raman scattering (SERS) of silver-shelled gold nanorods (Ag-Au NRs). Significant electric field enhancement has been achieved with the employment of bimetallic nanostructures which enabled excellent selective detection of cholesterol and triglycerides. The fourth technical chapter involves modelling of the community transmission of SARS-CoV-2 to study the spreading of COVID-19 infection considering external temperature and relative humidity mediated miniaturization of respiratory droplets using computational fluid dynamics (CFD) model in COMSOL Multiphysics. The study explores droplet trajectories and disease transmission under various conditions, including different air breezes, droplet size distributions, and evaporation effects influenced by geographic temperature and humidity. Furthermore, extensive kinetic studies for infected droplet evaporation were mapped against COVID-19 transmission data from multiple cities to validate the model. Overall, this thesis contributes to advancing non-invasive diagnostic techniques and understanding disease transmission dynamics, offering significant implications for public health and clinical practice.