Plasmonic Sensing of Oncoproteins without Resonance Shift Using 3D Periodic Nanocavity in Nanocup Arrays

A sensor design and sensing method based on plasmonic–photonic interactions that occur when a nanocavity array is embedded in a 3D tapered nanocup plasmonic substrate are reported. This device enables highly sensitive detection of refractive index changes based on changes to the transmission peak intensity without shift in the resonance wavelength. Unlike conventional plasmonic sensors, there is a consistent and selective change in the transmission intensity at the resonance peak wavelength with no spectral shift. In addition, there are wavelength ranges that show no intensity change, which can be used as reference regions. The fabrication and characterization of the plasmonic nanocavity sensor are described and also advanced biosensing is demonstrated. Simulations are carried out to better understand the plasmon–photonic coupling mechanism. This nanocavity plasmonic sensor design has a limit of detection of 1 ng mL$^{-1}$ ($5 \times 10^{-12}$m) for the cancer biomarker carcinoembryonic
antigen (CEA), which is a significant improvement over current surface plasmon resonance systems, and a dynamic range that is clinically relevant for human CEA levels.
