Multilayer-tuned surface plasmon modes using molecular nanolayer of (3-mercaptopropyl)trimethoxysilane applicable for nanobiosensing application.

ABSTRCT

Advanced techniques in nanofabrication are essential in order to manifest theoretical works in establishing nanobio-sensor devices. Metal-insulator-metal (MIM) geometry has been effectively used for tuning plasmonic effect that dramatically altered biosensor sensitivity. Normally, adhesive metal at metal-insulator interface; sub-nm chromium is required to stabilize the metallic nano-layer structure. This deteriorates the performances of the MIM sensors, by severely damping the plasmon modes. We replaced the commonly used sub-nm Cr with an organic molecular layer of (3-Mercaptopropyl) trimethoxysilane; MPTMS, as an adhesive molecule to strengthen the structure of the MIM-based biosensor. This successfully demonstrated a non-deterioration plasmon effect due to no imaginary part exist in the refractive index of the MPTMS. The new structure of metal/(MPTMS)/insulator/(MPTMS)/metal, instead of metal/(Cr)/insulator/(Cr)/metal or metal/poly(methyl methacrylate) or PMMA/metal was used as biosensing platform to detect molecular interactions. We simulated the biosensing concept using transfer matrix methods and construct the theoretically optimized MIM structure. The metal (Au) thin-layer was prepared by means of thermal evaporation method on a pre-cleaned glass slide. MPTMS is then deposited using solution deposition technique. This enables larger usable area on the MIM platform that can be utilized as the sensing area compared to an MIM using PMMA as insulator layer.

Keyword: Metal-insulator-metal; (3-Mercaptopropyl)trimethoxysilane; Adhesion layer; Plasmon damping; Label-free detection method; Protein interactions.