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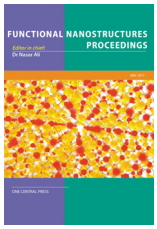

Biotin Functionalized Titanium Nitride Film for label-free Surface Plasmon Resonance Biosensing

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ABSTRACT

Titanium nitride (TiN), a ceramic transition metal nitrides (TMNs) material with exceptional physical and chemical properties, has attracted tremendous scientific and technological interest in past decades [1-5]. Although the promised plasmonic properties of TiN have been studied widely, and most of them predicted the possibility of TiN as an alternative plasmonic material for label-free biosensing [6-8], there are only a few studies that utilized TiN in the surface plasmon resonance (SPR) application of biochemical sensing. In 2014, we first reported the feasibility of using the TiN for biosensing via a computational study [1]. In the present work, we report actual biosensing using TiN thin film deposited directly on BK7 glass substrate by magnetron sputtering method. Based on a common-path optical sensing system, the TiN film was found to exhibit good SPR sensing performance toward ambient refractive index with features of: (1) tunable evanescent plasmonic field from 573 nm to 627nm; (2) excellent sensitivity of 1.93×10^{-7} RIU with film thickness of 29.8nm; (3) wide dynamic range covering 3.2×10^{-2} RIU. In addition, the sensing performance can be further improved by creating a nanostructure on the TiN film similar with gold nanoislands on BK7 glass substrate [9]. The random nanoholes on TiN film could effectively couple the stimulated hot-electron and improve plasmonic sensitivity.

In this presentation, we would illustrate the biosensing capability using TiN film. Experimental and computational adsorption results of TiN films to biotin molecules via the titanium-oxygen reaction and formation of chemical bonds will be shown. The immobilized biotin molecules will be seen to have good activity to combine with streptavidin. TiN film will be directly functionalized with biotin or biotinylated molecules, followed by label-free detection of biomolecules, using the detection of exosome as an example. Such detection would be important to distinguish exosomes from extracellular vesicles in cancer cells.

In consideration of its excellent mechanical properties over conventional plasmonic materials, TiN thin film and nanostructures would have great potential in scientific and commercial biosensing applications.

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