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Silver Nanoislands for Plasmonic Detection of Proteins

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Extended Abstract

Deposition of metallic nanostructures on an optically transparent substrate is an important process step in the fabrication of localized surface plasmon biosensors. Various methods of deposition of nanostructures on substrates are thermal and e-beam deposition or sputtering and heat treatment, self-assembly through convective process, etc. (Alet et al., 2008; Szunerits et al., 2008; Gaspar et al., 2013). We have previously reported a novel method of formation of gold nanoislands on glass substrate by convective assembly and post-deposition annealing (Ozhikandathil et al., 2012; Ozhikandathil et al., 2012; Ozhikandathil and Packirisamy, 2012; Ozhikandathil and Packirisamy, 2014). The gold nanoisland sensor was tested for the detection of bovine growth hormone with the detection limit as low as 5ng/ml.

In this work, a simple and novel method of manufacturing silver nanoislands is described. The colloidal silver nanoparticle solution was prepared by reducing ion by sodium borohydride. The surface of the glass substrate has been activated by oxygen plasma treatment. The manufacturing of silver nanostructure involves two steps, namely, convective assembly and post-deposition annealing. The silver nanoclusters was deposited by convective assembly at temperatures between 70 to 100 ^{0}C. The convective assembly resulted in silver nanoclusters on the glass substrate. The nanocluster morphology was transformed to widely separated nanoislands by post-deposition annealing. The size distribution and optical absorbance properties of nanoislands is characterized by scanning electron microscopy and UV-Visible spectroscopy, respectively. The nanoclusters shown in Figure 1(a) are found to have a wide optical absorbance spectrum due to the strong interparticle field coupling effects. The nanoclsuter morphology was tuned to nanoislands as shown in Figure 1(b) by annealing at above 500 ^{0}C. The size of nanoislands is found to be in the range of 50 to 200nm.

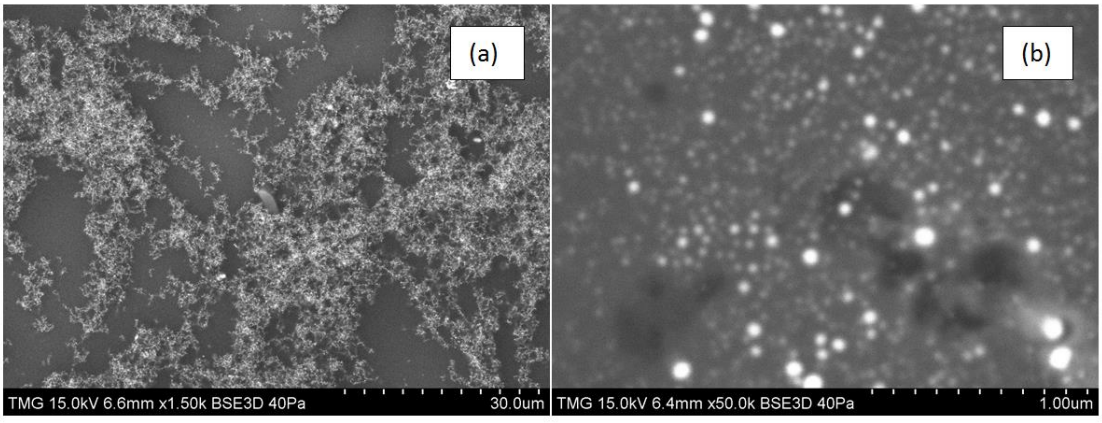

Fig. 1. (a) SEM image of (a) silver nano cluster (b) silver nanoislands

The sensitivity of the nanoislands sensing platform towards the refractive index is investigated using various standard solvents and found that the proposed platform has a significantly high sensitivity. Further the biosensing capability of the silver nanoislands was tested by sandwich immunosensing. The platform was functionalized before adsorbing the antibody and subsequent interaction with the corresponding antigen was quantified by the shift of the silver localized surface Plasmon resonance (LSPR) band. We have tested several thiol linkers and cross-linkers to adsorb the antibody on to the silver nanoislands and optimized the sensing protocol. Then a sensor calibration curve has been established and we found that the proposed silver nanoislands could be used for the detection of protein in the level of few ng/ml. The optical absorbance properties of the silver nanoislands was also investigated using the finite-deference-time domain technics, which showed that the LSPR band obtained theoretically and experimentally are in good agreement.

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