World Academy of Science, Engineering and Technology
International Journal of Biotechnology and Bioengineering
Vol:11, No:02, 2017

Nano-Plasmonic Diagnostic Sensor Using Ultraflat Single-Crystalline Au Nanoplate and Cysteine-Tagged Protein G

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Abstract : Nanosensors for high sensitive detection of diseases have been widely studied to improve the quality of life. Here, we suggest robust nano-plasmonic diagnostic sensor using cysteine tagged protein G (Cys3-protein G) and ultraflat, ultraclean and single-crystalline Au nanoplates. Protein G formed on an ultraflat Au surface provides ideal background for dense and uniform immobilization of antibodies. The Au is highly stable in diverse biochemical environment and can immobilize antibodies easily through Au-S bonding, having been widely used for various biosensing applications. Especially, atomically smooth single-crystalline Au nanomaterials synthesized using chemical vapor transport (CVT) method are very suitable to fabricate reproducible sensitive sensors. As the C-reactive protein (CRP) is a nonspecific biomarker of inflammation and infection, it can be used as a predictive or prognostic marker for various cardiovascular diseases. Cys3-protein G immobilized uniformly on the Au nanoplate enable CRP antibody (anti-CRP) to be ordered in a correct orientation, making their binding capacity be maximized for CRP detection. Immobilization condition for the Cys3-protein G and anti-CRP on the Au nanoplate is optimized visually by AFM analysis. Au nanoparticle - Au nanoplate (NPs-on-Au nanoplate) assembly fabricated from sandwich immunoassay for CRP can reduce zero-signal extremely caused by nonspecific bindings, providing a distinct surface-enhanced Raman scattering (SERS) enhancement still in 10-18 M of CRP concentration. Moreover, the NP-on-Au nanoplate sensor shows an excellent selectivity against non-target proteins with high concentration. In addition, comparing with control experiments employing a Au film fabricated by e-beam assisted deposition and linker molecule, we validate clearly contribution of the Au nanoplate for the attomolar sensitive detection of CRP. We expect that the devised platform employing the complex of single-crystalline Au nanoplates and Cys3-protein G can be applied for detection of many other cancer biomarkers.

Keywords : Au nanoplate, biomarker, diagnostic sensor, protein G, SERS
Conference Title : ICANN 2017 : International Conference on Advanced Nanoscience and Nanobiotechnology
Conference Location : London, United Kingdom
Conference Dates : February 16-17, 2017

Open Science Index, Biotechnology and Bioengineering Vol:11, No:02, 2017 publications.waset.org/abstracts/61369.pdf