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Stabilization of gold and silver nanoparticles for LSPR sensing operating in both visible and near-IR regimes in high salt concentration environments

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We describe an LSPR sensor based on cap-shaped noble metal nanoparticles, prepared with a metal film on nanospheres (MFON) method. In contrast to the standard MFON, we use randomly adsorbed nanospheres that significantly facilitate the fabrication process without any sacrifice in performance. Moreover, adding a 20 nm thick Au layer beneath the nanosphere layer was found to lead to a pronounced increase in the absorption peak. The nanosphere diameter is typically 100~150 nm with the top metal layer thickness in the range of 20 nm. These samples are characterized by peaks both in visible and near-IR regimes. The near-IR peak has refractive index dependence greater than 500 nm/RIU, some four times better than the visible peak. While the improved sensitivity is very encouraging, we need to overcome a number of technical challenges before we can implement the sensor for characterization of antibodies as pharmaceuticals; in particular the presence of NaCl leads to an overall drift in the peak wavelength which is attributed to change in nanoparticle morphology. We have solved this problem by coating nanoparticles with a layer of various thiol molecules. Those thiols were either sublimed or vaporized. Vaporized 1-butanethiol was found to be better at protecting the nanosphere layer. We also found that the same set of thiol treatments could stabilize Ag nanoparticles which are normally considered as too reactive for use as a sensor material. We foresee applications such as *in-situ* characterization of antibodies while still in the fermentation process or immediately prior to use.

Biography

H Haraguchi obtained her BA from the Faculty of Life Sciences of Toyo University in March 2017 and is currently enrolled in the Graduate School of Life Sciences at Toyo University. In the course of her undergraduate studies, she has become interested in life-sciences related technologies with near-future commercial impacts. Localized surface plasmon resonance sensors appealed to her as one such technology, and she has concentrated on improving the sensor stability and reproducibility of signals. Having discovered that some relatively short alkanethiols were surprisingly well suited for stabilizing noble metal nanoparticles, she made her first presentation at the 76th Annual Conference of the Japan Society for Analytical Chemistry on this finding. For this, she was given a Young Scholar's Award. Currently she is principally interested in optimizing the surface passivation protocol based on the above discovery, with an aim of submitting a patent application under the supervision of Prof. H Takei. Specifically, she intends to exploit unique characteristics of LSPR sensors over more traditional SPR sensors for assessment of antibodies for therapeutic uses.

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