Photo-induced functionalization of gold nanorods for biosensing of proteins

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Gold nanoparticles of elongated shape, such as gold nanorods, display longitudinal surface plasmon (LSP) resonances that are very sensitive to the refraction index close to the particle's surface. One type of biosensors that exploits this feature for optical detection of biomolecules are plasmonic biosensors.[1] But commonly, the particle's sensitivity is not homogeneously distributed across the surface, instead it is concentrated at regions of large plasmon-enhanced near-field, known as hot-spots. An example of plasmon hot-spots are the tips of gold nanorods. Thus, tip-selective functionalization of these hot-spots with bioreceptors is crucial to develop plasmonic biosensors with improved response by capturing the target species at the most sensitive regions of the particle.[2] In this contribution, we show a novel strategy that aims at tip-selective functionalization of gold nanorods implemented in a model plasmonic biosensor. For this purpose, we use a photocrosslinking reaction to attach biotin receptors onto gold nanorods immobilized on a glass surface (Figure 1A). The photochemical reaction is performed by irradiation at the LSP's wavelength in order to trigger photo-conversion at the plasmon-enhanced near-field regions, thus imparting spatial selection of hot-spots. The irradiated samples show improved responses to the protein streptavidin compared to non-irradiated control samples, as expected for biotin-functionalized particles (Figure 1B). The dose-response curve shows that the LSP peak position red-shifts as protein concentration increases in the nanomolar range and it saturates at a peak shift of ca. 4 nm (Figure 1C). This approach can be generalized to any anisotropic particle shape and to any other type of bioreceptor, e.g. antibody, aptamer or other nucleic acid, being thus important for the development of innovative and more sensitive biosensors, for example for medical diagnostics.

REFERENCES

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FIGURES

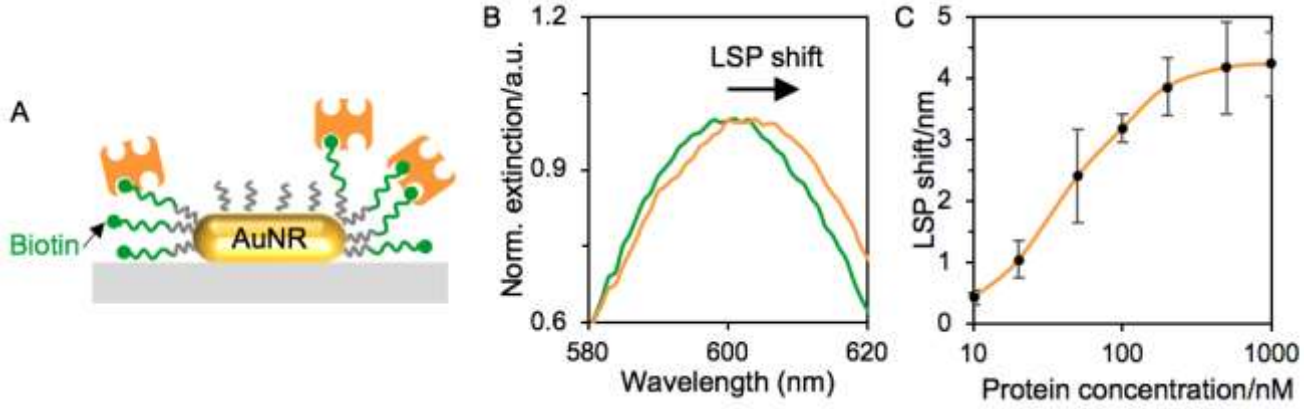

Figure 1: Biosensing of streptavidin protein using photo-induced tip-functionalized gold nanorods. (A) Model plasmonic biosensor. Gold nanorods are tip-functionalized with a biotin-derivatized photocrosslinker (green) and then used for sensing streptavidin (orange). (B) Streptavidin causes a change in the refraction index around the gold nanorod, which is detected by a shift in the LSP peak of the particle. (C) Dose-response curve for streptavidin showing a high LSP shift of around 4 nm for the higher concentration of protein.