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DNA-Nanoparticle Conjugates constructed with DNA-loops

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Noble metal nanoparticles commonly exhibit narrow adsorption/scattering peak in the visible part of spectrum caused by the localized surface plasmons (LSP). The resonance frequency of LSP depends on the size of the particles and the permittivity of the surrounding medium [1]. Binding events in close vicinity of such nanopartcle will therefore lead to a change in the LSP resonance frequency; several designs of biosensors using this effect were suggested recently (see for example [2]). When a metal nanoparticle is placed in close proximity to a metal film, LSP in the nanoparticle can couple to the surface plasmon polaritons (SPP) in the metal film. The interaction between the SSP in the metal film and LSP in the nanoparticles depends critically on the nanoparticle-film distance [3].

Gold nanoparticles have been the far most used noble metal nanoparticles, mainly due to their relatively high stability. However, in comparison to gold, silver nanoparticles offer a range of advantages, including a higher sensitivity due to a narrow LSP peak and the possibility to use metal surface enhanced fluorescence to name a few [4]. Unfortunately, the modification techniques for silver nanoparticles are not as well elaborated as those for gold nanoparticles. In this work we achieved stabilization of bare silver nanoparticles using hairpin-structured DNA molecules with the phosphorothiolated hairpin area. The binding of hairpin DNA to silver nanoparticles can be observed as a red shift and a broadening of the surface plasmon peak of the nanoparticles (see Fig 1). The particles acquire negative charge due to the attached DNA molecules and are stable at least on a scale of several weeks. Gel electrophoresis confirmed binding of DNA molecules to the nanoparticles: DNA stabilized silver nanoparticles formed a well defined band in the gel, while the non-modified silver nanoparticles couldn't enter the gel.

We believe that this type of DNA-Ag nanoparticle construct offers unique possibilities for measuring the coupling of LSP and SPP providing a well defined separation between the nanoparticles and the metal film. Moreover this construct could be used to measure electrical transport through short DNA segments. We will present some preliminary data covering these areas of research.

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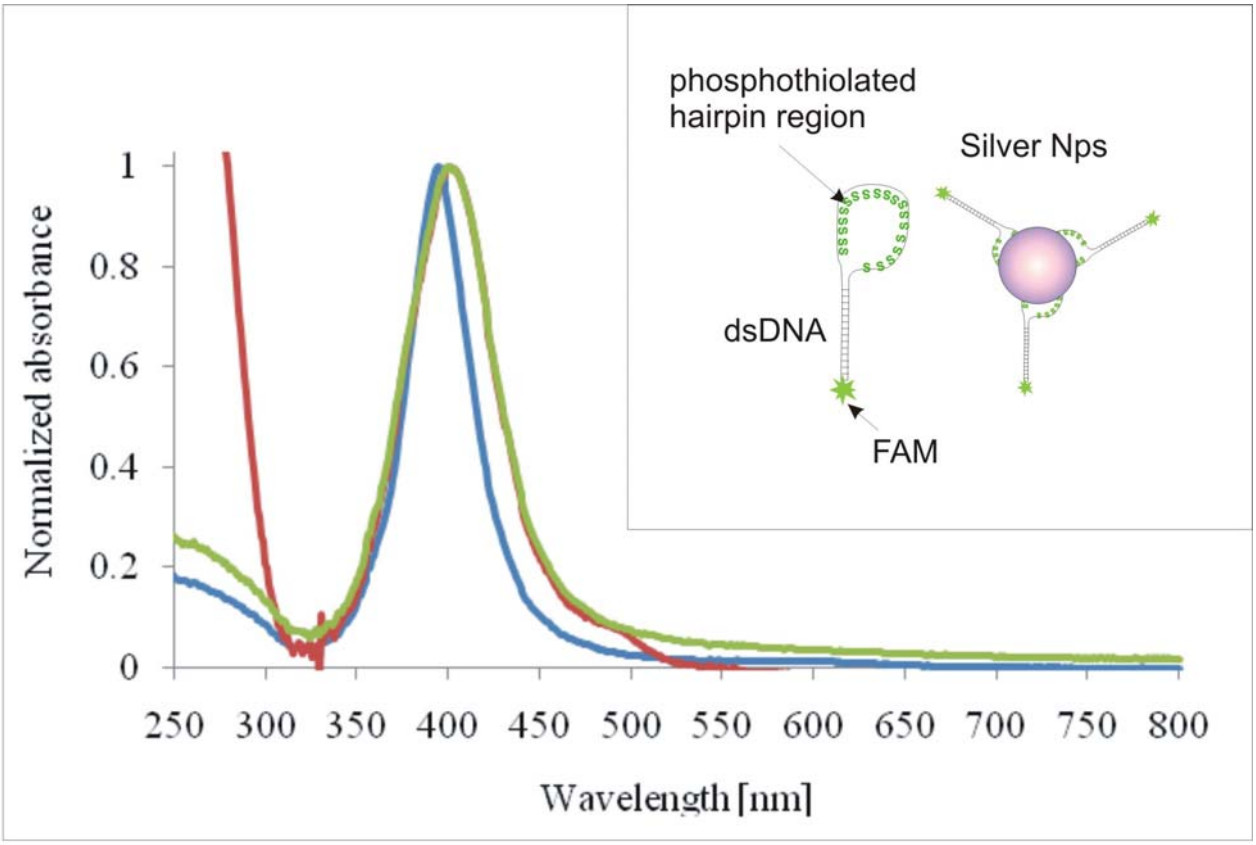

Figure 1: Absorption spectra of silver nanoparticles (blue) and silver nanoparticles with bound hairpin DNA before (red) and after (green) centrifugation. The spectra are normalized at the maximum value of the surface plasmon peak, which is observed around 400nm.