Self-assembly of molecules and nanoparticles on gold nanorods

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Gold nanorods with spatial compositional inhomogeneity of the surface attached ligands feature special physicochemical properties depending on the nature of the surface chemical patch. By investigating single patchy gold nanorods with correlative microspectroscopy and atomic force microscopy (AFM) measurements we show that cysteamine creates well-defined patches in the tip region of 115 x 55 nm gold nanorods at 10^{-2} mM concentration (Fig. 1). Optical scattering spectra calculated as a function of tip coverage and shell refractive indexes support the spectral changes upon patch formation. These observations allow a more rational design of complex composition of nanoparticle ligand shells [1].

On the other hand, proper surface-modification of gold nanorods can be also utilized in the preparation of nanoparticle heterodimers by self-assembling nanorods with spherical gold nanoparticles in aqueous medium. After the assembly ex-situ by electron microscopy investigations show that both particles are usually located at the substrate level (sphere in a 'side arrangement') but occasionally some spherical particles are found to be located on top of the gold nanorods ('top arrangement'). Hence, we also investigate the spatial arrangement of the particles in-situ in water upon assembly by microspectroscopy to conclude on the spatial arrangement of individual heterodimers. It is shown that in contrast to the plain white light scattering spectrum, polarization resolved spectra can be used to distinguishing between the two main arrangements (Fig. 2). It is demonstrated that both arrangements can be formed during the assembly and that nanospheres - originally located on top of the rods - can rearrange and shift to the substrate level upon drying, presumably due to immersion type capillary forces [2].

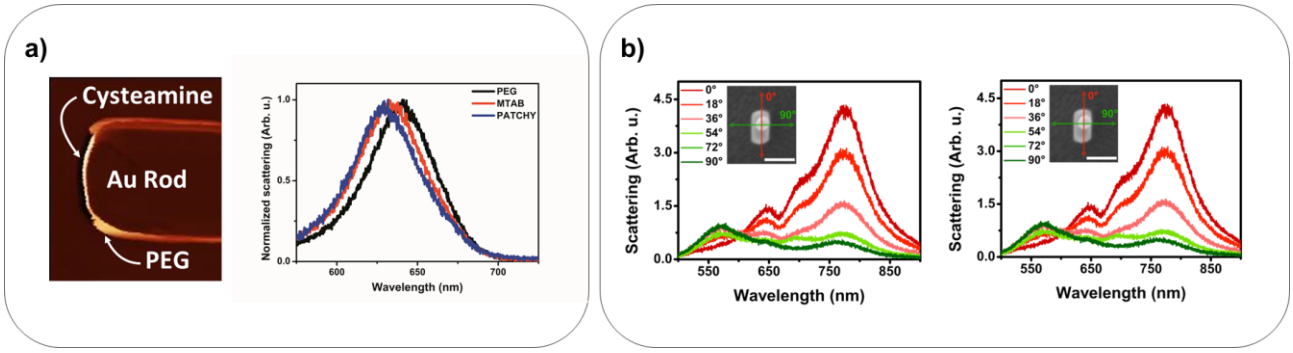

Figure 1. AFM deformation map of an individual patchy nanorod and scattering spectra of particles featuring different surface ligands (a) Polarization resolved spectra and SEM micrographs for the top and the side-arranged heterodimers (b)

[1] D. P. Szekrényes, S. Pothorszky, D. Zámbó, Z. Osváth and A. Deák, J. Phys. Chem. C, 2018, 122 (3), 1706.
[2] D. P. Szekrényes, S. Pothorszky, D. Zámbó and A. Deák, PCCP, 2019, accepted

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