

Supporting information

“Monitoring the gold nanoshells growth mechanism: stabilizing and destabilizing effects of PEG-SH molecules”

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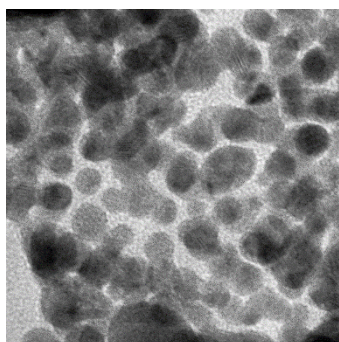
TEM and EDX characterization at various stages of the gold nanoshells synthesis

The synthesis was characterized at various stages, and the results confirm the controllable and highly reproducible synthesis of the gold nanoshells and further surface modification with PEG-SH molecules.

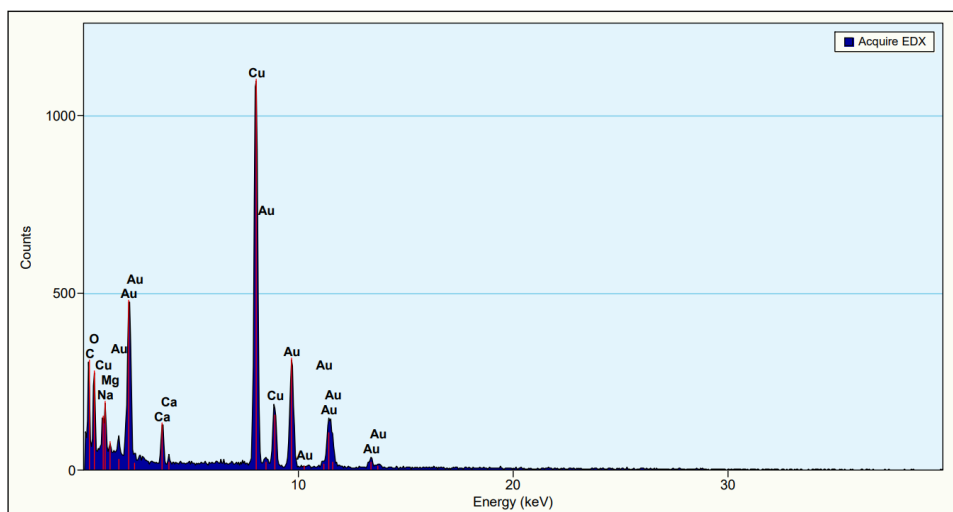
a) THPC nanoparticles

At first, we have prepared the THPC nanoparticles with sizes in the range 2-3nm. For the TEM measurements, the sample was deposited on the copper grids covered by an organic membrane, which prevents the nanoparticles from percolating through the grids after deposition. The signals from oxygen and carbon on EDX measurement come from this organic membrane uniformly covering copper grid.

TEM image of THPC nanoparticles:



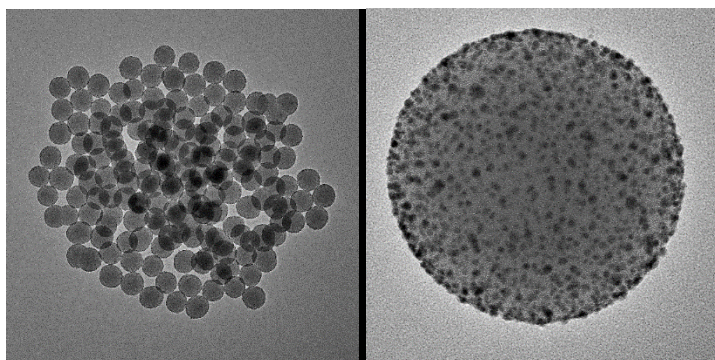
EDX of THPC nanoparticles:



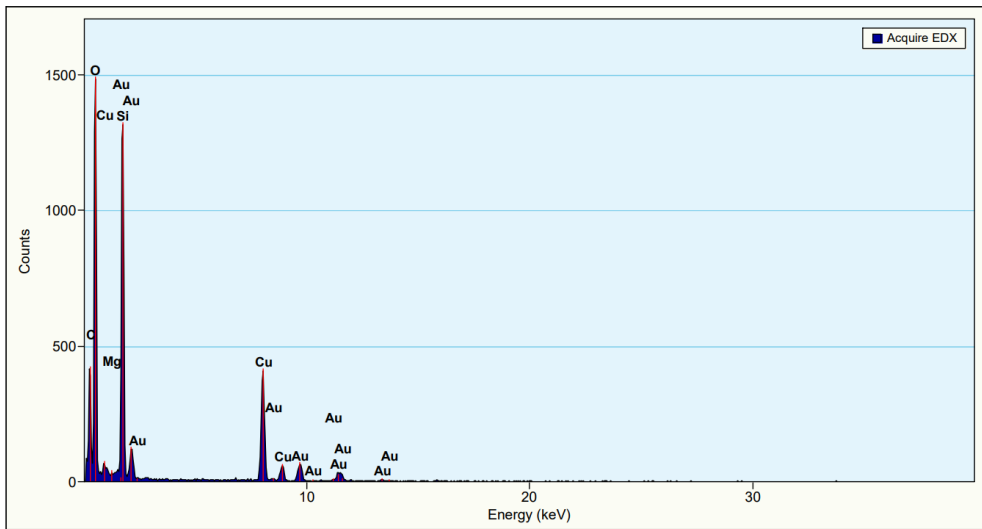
b) Seed nanoparticles

In the next stage, THPC nanoparticles were attached to the silica spheres, previously functionalized with APTES molecules. The final product is called a seed. TEM images (below) confirm that the synthesis results in monodisperse and high-quality seed nanoparticles.

TEM images of seed nanoparticles:



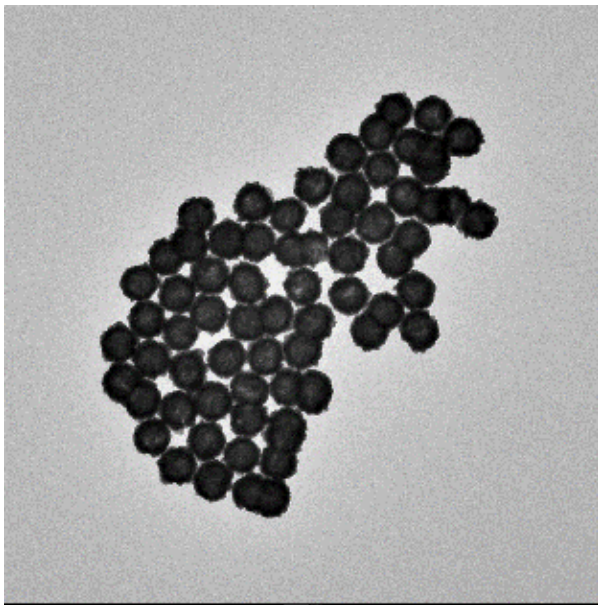
EDX of seed nanoparticles:



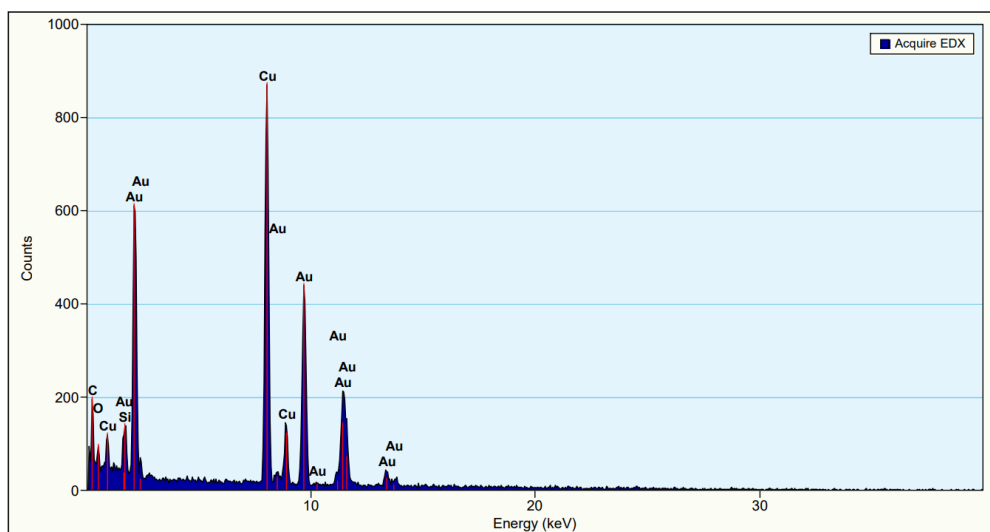
c) Gold nanoshells

During the synthesis of gold nanoshells, the thickness of the gold layer and its roughness is well controlled. An example TEM image confirm the synthesis of a monodisperse sample.

TEM image of completed gold nanoshells:



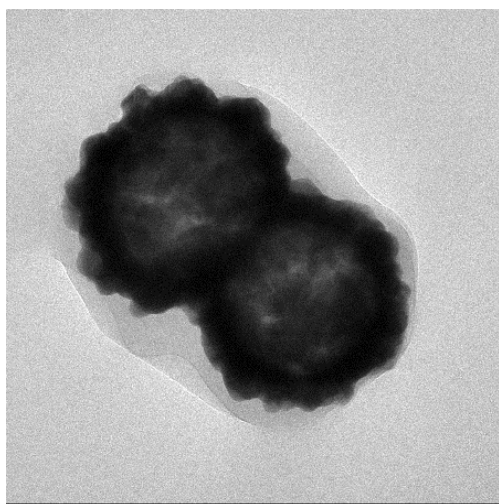
EDX of completed gold nanoshells:



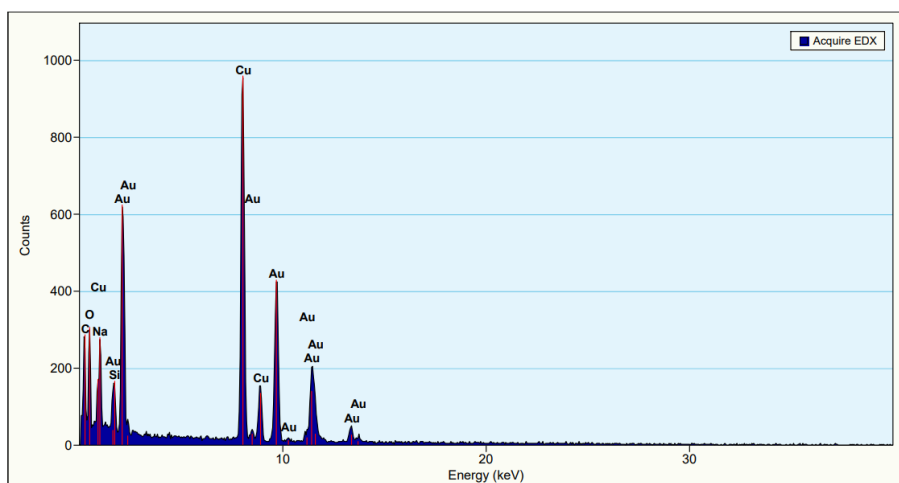
d) Gold nanoshells with PEG-SH layer

Successful functionalization of the gold nanoshells by PEG-SH is demonstrated by various techniques, as presented in the main article: FT-ATR spectra (Fig. 4), Raman spectra (Fig.5), absorption measurement (red-shift of the absorption band due to the change of the surrounding refractive index) (Fig.8), TEM images (Fig. 7 c, d). Here, we also present additional TEM images and the EDX analysis. We have carefully analyzed the same gold nanoshells without surface functionalization (see: previous stage) and with PEG-SH molecules. The nanoparticles with PEG-SH were deposited on the copper grids covered by organic layer. Their concentration was the same as the concentration of nanoshells without PEG-SH studied in the previous stage. The observed Au signal is on the same level in both cases, while the intensity of the signal coming from oxygen and carbon increases from 200 counts to 300 counts, which is another evidence of the coating of nanoshells by PEG-SH layer.

TEM image of gold nanoshells with PEG-SH:



EDX of gold nanoshells covered by PEG-SH molecules:



Our attempts to functionalize uncompleted gold nanoshells by PEG-SH resulted in detachment of the gold layer from the silica spheres. There is no easy way to control the detachment degree, because increased PEG-SH concentration causes precipitation and sedimentation of the sample. TEM images (below) show that the gold coating has been detached from the silica spheres, and the gold islands aggregate in the spaces between the silica spheres.

TEM pictures of uncompleted gold nanoshells after PEG-SH functionalization

