MICROWAVE-ASSISTED SYNTHESIS OF GOLD-SILVER BIMETALLIC NANOPARTICLES

Edita Daublytė[1*], Tatjana Charkova[2]

[1] Life Sciences Center, *Vilnius University, Lithuania*
[2] *Department of Organic Chemistry, Center for Physical Sciences and Technology, Lithuania*
**editadaublyte@gmail.com*

Bimetallic nanoparticles, composed of two different metals, has higher catalytic, electronic, optical, and other properties than the corresponding monometallic particles. Bimetallic Au-Ag nanoparticles extend the surface plasmon resonance range (defined by UV-Vis absorption band) compared with single metal nanoparticles. Such an effect allows to probe molecules in wider Raman excitation range. [1]. Shell-isolated nanoparticle-enhanced Raman spectroscopy (SHINERS) is a non-destructive and sensitive method which can be applied to detect low concentrations of different analytes. For this application in order to improve stability and biocompatibility of the nanoparticles various coatings (SiO_2, MnO_2,TiO_2, etc.) are widely used [2].

Chemical reduction is one of the most commonly used methods for the synthesis of bimetallic nanoparticles. It allows flexibly modify composition, size, and shape of particles [1]. Compared with other synthesis conditions, microwave-assisted synthesis is becoming increasingly popular. It helps to reduce reaction time, energy consumption, and size distribution of the nanoparticles [3].

In this work 30±5 nm Au-Ag bimetallic nanoparticles were successfully synthesized under microwave irradiation. The formed uneven 1-4 nm silica (SiO_2) shell avoided direct chemical and electrical contact of the nanoparticles (Au-Ag@SiO_2) with analyte, and environment (Fig. 1). In order to apply the obtained nanoparticles, a self-assembled monolayer of 4-mercaptobenzoic acid (4-MBA) was formed onto a gold plate and Au-Ag@SiO_2 nanoparticles were spread on it to amplify the Raman signals. The clear enhanced SHINERS spectrum of 4-MBA on a smooth gold plate was obtained (Fig. 2).

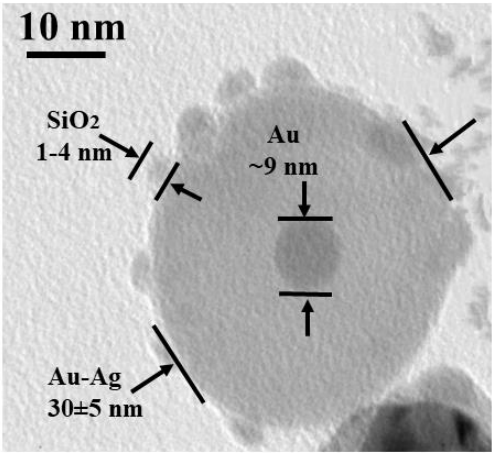

Fig. 1. HR-TEM images of 30±5 nm Au-Ag@SiO_2 nanospheres with 1-4 nm of silica shell.

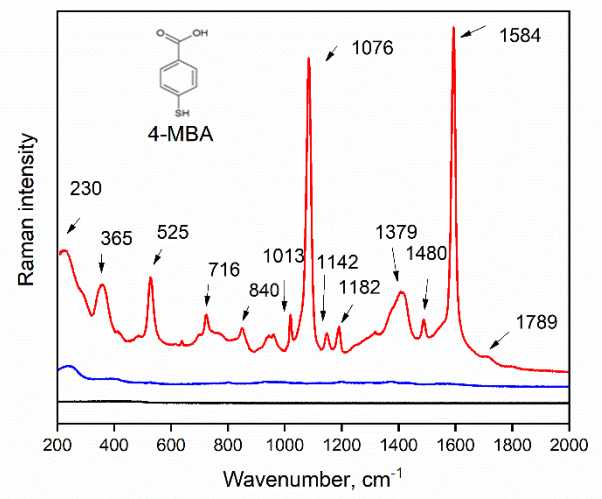

Fig. 2. Raman spectrum of 4-MBA adsorbed on a smooth Au surface without nanoparticles (A – black), Raman spectrum of Au-Ag@SiO_2 nanoparticles (B – blue) and SHINERS spectrum of 4-MBA with Au-Ag@SiO_2 nanoparticles.

References

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