Synthesis of the new type of silver SHINERS nanoresonators with decahedral shape and their application in Raman spectroscopy

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In this work, we report the synthesis of decahedral silver nanoparticles with silica layer which are very new type of SHINERS nanoresonators with many sharp apexes and edges. We also show their application for Raman studies of some molecules and yeast cells.

The synthesis of decahedral silver nanoparticles was carried out using method developed by Kitary et al. [1]. Synthesized nanoparticles had mainly decahedral shape with average size of 43 nm. Synthesis of thin silica layer on their surface was carried out using method developed by Mirkin et al. [2].

Comparison studies of decahedral and spherical nanoparticles as Raman nanoresonators were carried out by measuring Raman signal of monolayer of 4-mercaptobenzoic acid (PMBA) deposited on Pt plate and covered with respective nanoparticles. These studies showed that enhancement factor of used nanoparticles was approximately ten times higher in case of decahedral nanoparticles.

Decahedral-Ag@SiO2 nanoparticles have been tested in SHINERS measurements of monolayers of PMBA on Pt and in measurements of model biological samples. Figure 1 shows Raman spectra of Saccharomyces boulardii (yeast) cells before and after deposition of decahedral-Ag@SiO2 nanoparticles. As can be seen in this Figure, in the Raman spectrum recorded with the decahedral-Ag@SiO2 nanoparticles many Raman bands (e.g., at 1135, 1315, 1346, 1456, 1611, 1665 cm⁻¹) can be clearly identified, whereas in a case of the Raman spectrum recorded without nanoresonators it is very hard to distinguish these bands from the noise.

![Fig. 1. Raman spectra of Saccharomyces boulardii cells without nanoparticles (black curve) and after addition of decahedral-Ag@SiO2 nanoparticles (red curve).](image)

Keywords: SERS, SHINERS, nanoparticles

References