SURFACE-ENHANCED RAMAN SPECTROSCOPY SUBSTRATES BASED ON NATURAL CERAMIC NANOTUBES

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Abstract

In the last decades surface-enhanced Raman scattering (SERS) was investigated on the numerous gold and silver substrates including aggregated nanospheres, nanorods, nanostars, nanotubes and so on. Size and shape of the nanostructures used as the SERS substrate determine the enhancement factor of SERS and the spectral range in which SERS can be excited.

In our previous work, metal-halloysite SERS substrates were prepared by vacuum evaporation of different metals [Vinokurov et al., 2015. DOI: 10.1007/s11837-015-1494-5].

In this study, we have developed a SERS substrate by adsorption of gold nanostars on amino and mercapto-modified halloysite nanotubes. This substrate has several advantages: SERS performance is achieved not only by the surface roughness, but also by the hot spots between the particles close to each other, between the branches of nanostars and on the branches' tips. Additionally, wet chemistry methods used for creating the SERS substrate are cheap and widely available. The gold nanostars were synthesized by method of Cheng et al., 2012 [DOI:10.1039/C1JM13937A]. As revealed by UV-Vis-NIR spectroscopy and transmission electron microscopy, the nanostars are unstable and change within few minutes to the spherical shape. In order to obtain the stable SERS substrate, the nanostars have to be stabilized, but without changes in their SERS activity.

It was found that the gold nanostars adsorbed on the modified halloysite nanotubes keep the initial shape and SERS activity. Nanostars-halloysite SERS substrates do not agglomerate, and could be concentrated or dried without loss of their useful properties.

Keywords: SERS, nanostars, halloysite

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