Nanostructured surfaces

Underpotential deposition as a sensitive method for probing the surface of Au nanoparticles deposited on TiO_2 electrodes

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Gold nanoparticles (Au NPs) are expanding area of research due to a variety of applications in sensing and catalysis [1]. The activity of Au NPs is strongly influenced by their size, shape, morphology and the nature of support material. Therefore, the synthesis and characterization of Au NPs are important issue to any study. In this report we apply underpotential deposition technique (UPD) for probing the surface of Au NPs deposited onto TiO_2 nanotubes. Along with electrochemical approach, we use another methods (SEM, TEM, UV-vis spectroscopy) to characterize size, shape and optical properties of Au NPs.

Au NPs were loaded onto TiO_2 nanotubular layers (TNT) by photocatalytic reduction of Au(III) using different techniques. In the first approach, Au NPs were deposited by direct UV-irradiation of the TNT electrode emerged into the solution (TNT-Au_1). According to the second way, Au(III) ions were initially adsorbed onto the TNT surface and then irradiated by UV light (TNT-Au_2).

The size of the deposited Au NPs depends on the deposition technique and is ~ 13 nm for TNT-Au_1 and ~ 25 nm for TNT-Au_2. Optical spectra exhibit an absorption band peaked at 520 nm and 540 nm, respectively. Lead UPD on Au NPs occurs in the potential range from 0.1 to -0.4 V. There are three cathodic peaks at -0.07, -0.12 and -0.24 V and three coupled anodic peaks at -0.03, -0.13 and -0.23 V for both electrodes. The potential value for the observed peaks is close to the respective peaks of lead UPD on Au bulk electrodes. However, the relative intensities of observed peaks point on the predominance of [111] crystallographic orientation for TNT-Au_1 and [100] orientation for TNT-Au_2. Moreover, the real surface area of the deposited Au NPs can be evaluated from the UPD data.

Thus, UPD is a sensitive technique for studying the surface of Au NPs, allowing elucidate their structural peculiarities and true surface area.

1. *Thompson, D.T.* Using gold nanoparticles for catalysis // Nanotoday. -2007.-**2**, N 4.-P. 40-43.