NEW STAINLESS STEEL ASSISTED SYNTHESIS OF BARE GOLD NANOPARTICLES AND APPLICATION TO SERS DETERMINATION OF CARBON NANOTUBES.

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Most synthetic methods for the production of noble metal nanoparticles in suspension utilize a precursor salt, a reductant, and a stabilizer to provide electrostatic or steric stabilization to the particles. Conventional synthesis have used as reductants sodium citrate, sodium borohydride, ascorbic acid, ethylenediaminetetraacetic acid (EDTA) or cyanoborohydride. However, the presence of these foreign adsorbates affects the optical characteristics of the plasmon band of the particles as well as their photochemical reactivity.

In this work bare gold nanoparticles (AuNPs) have been synthesized from tetrachloroauric acid using steel or stainless steel as solid reducing agent. The proposed green synthesis method yields bare AuNPs at atmospheric pressure and room temperature for potentially producing large quantities, whereas the methods described to date to achieve nanoparticles without ligands usually require more complex reaction conditions such as e.g., molecular hydrogen at a pressure slightly higher than atmospheric conditions. In addition, with this procedure, by simply controlling time and temperature, the size of the synthesized nanoparticles may be tuned.

If steel or stainless steel is inserted into a tetrachloroauric acid solution, the homogenous formation of gold nanoparticles in solution is observed along with a small amount of AuNPs formed at the surface of the solid reducing agent. The obtained AuNPs have been characterized by UV/vis, scanning electron microscopy (SEM), transmission electron microscopy (TEM), and atomic force microscopy (AFM) in order to determine their size and shape. ICP-OES and EDX have been used for elucidating the reaction mechanism.

Obtained bare gold nanoparticles have proved to produce an enhancement in the Raman spectrum of c-SWNTs. SERS measurements were performed on a substrate composed of AuNPs on commercial acetate of cellulose (pore size of 0.2 µm) membrane, which is placed on a home-made microfiltration device. A suitable amount of AuNPs is filtered through it forming the SERS active substrate. Then, the adequate volume of aqueous sample containing the water soluble c-SWNTs is passed through the membrane, CNTs are adsorbed on the AuNPs previously deposited on the membrane and subsequently analyzed by Raman spectroscopy.

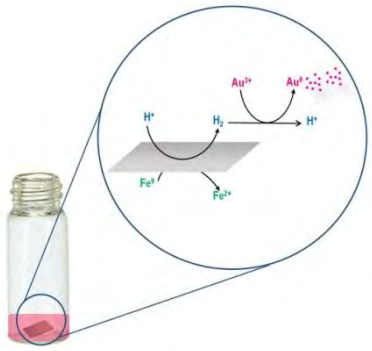

Figure 1. Scheme of stainless steel mediated AuNPs synthesis mechanism.