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Migrational Effect on the Formation of Gold Nanoparticle Thin Films Via Electrochemical Deposition Methods

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After the brief introduction of the migrational effect on mass transfer in electrochemistry, a controlled potential method for the formation of Au nanoparticle thin films using a linker molecule will be introduced. It is found that the interfacial electric field affects on the adsorption of Au nanoparticles. For 1,9-nonanedithiol (NDT) used as the linker molecule, experimental results demonstrate that adsorption process of NDT is associated with an electrochemical oxidation reaction. Induced potential affects molecular orientation, binding of headgroups and adsorption properties. For Au nanoparticles, the interfacial electric field governs the particle transport toward the linker molecule. Citrate stabilized Au nanoparticles have negative charge so the particle movement is accelerated by migration and the deposition rate decreases with increasing salt concentration in the presence of an applied field.

On a gold and ITO electrode, citrate stabilized Au nanoparticles and 1,9-nonanedithiol are used as elements and the effect of applied potential for the formation of Au nanoparticle thin film was characterized by cyclic voltammetry (CV), chronoamperometry (CA), scanning electron microscopy (SEM), scanning tunneling microscopy (STM) and UV-Vis spectroscopy. We examined Au nano-thin films via electrodeposition methods are formed much faster than other regular process and we can control the coverage of Au nanoparticles and linker molecule with potential variation.