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Electrochemical Properties of Bimetallic Silver-Platinum Core-Shell Nanoparticles

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Abstract : Silver-platinum (Ag-Pt) bimetallic nanoparticles (NPs) with varying mole fractions (1:1, 1:3 and 3:1) were prepared by co-reduction of hexachloroplatinate and silver nitrate with sodium citrate. Upon successful formation of both monometallic and bimetallic (BM) core shell nanoparticles, cyclic voltammetry (CV) was used to characterize the NPs. The drop coated nanofilms on the GC substrate showed characteristic peaks of monometallic Ag NPs; Ag+/Ag0 redox couple as well as the Pt NPs; hydrogen adsorption and desorption peaks. These characteristic peaks were confirmed in the bimetallic NPs voltammograms. The following varying current trends were observed in the BM NPs ratios; GCE/Ag-Pt 1:3 > GCE/Ag-Pt 3:1 > GCE/Ag-Pt 1:1. Fundamental electrochemical properties which directly or indirectly affects the applicability of films such as; diffusion coefficient (D), electroactive surface coverage, electrochemical band gap, electron transfer coefficient (α) and charge (Q) were assessed using Randles - Sevcik plot and Laviron's equations . High charge and surface coverage was observed in GCE/Ag-Pt 1:3 which supports its enhanced current. GCE/Ag-Pt 3:1 showed high diffusion coefficient while GCE/Ag-Pt 1:1 possessed high electron transfer coefficient that is facilitated by its high apparent heterogeneous rate constant relative to other BM NPs ratios. Surface redox reaction was determined as adsorption controlled in all modified GCEs. Surface coverage is inversely proportional to size; therefore the surface coverage data suggests that Ag-Pt 1:1 NPs have a small particle size. Generally, GCE/Ag-Pt 1:3 depicts the best electrochemical properties.

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