Abstract

Synthesis of Au nanoparticles of various shapes by chemical and electrochemical routes and their electrocatalytic and electroanalytical applications are described. The chemical synthesis of Au nanoparticles involves the reduction of Au(III) complex by eco-friendly reagent in aqueous solution to Au(I) and the subsequent disproportionation of the chemically generated Au(I) to Au(0). On the other hand, the electrochemical route involves the direct reduction of Au(III) complex to Au(0) under optimized conditions. The surface-confined Au nanoparticles of flower-like and raspberry-like morphology have been obtained by seed-mediated growth approach using the electrochemically deposited Au nanoseeds on the conducting support using equimolar concentration of hydroxylamine and $HAuCl_4$ in the absence and presence of iodide ions. In another approach Au nanoparticles of different shapes were obtained by direct electrochemical reduction of $HAuCl_4$. The electrochemical platforms based on Au nanoparticles have been developed for electrocatalytic applications. The electrocatalytic performance of chemically synthesized Au nanoparticles of dumbbell-like, peanut-like and polyhedral shapes have been exploited for the electroanalysis of glucose in neutral and alkaline pHs. The polyhedral nanoparticle-based electrode shows excellent catalytic activity towards glucose in both pHs. The surface-confined Au nanoparticles of flower-like and raspberry-like shape has been utilized for the oxidation of ascorbate and dehydroascorbate. The Au nanoparticles of (111) surface has been utilized for the simultaneous electroanalysis of As(III), Cu(II) and Hg(II). The electroanalysis of Cr(VI) is demonstrated using electrochemically synthesized raspberry-like nanoparticles. Au particles obtained by direct electrochemical route have been utilized for the oxidation of methanol and reduction of oxygen. The Au particle-based electrodes show a well-defined voltammogram for the oxidation of methanol and reduction of oxygen. The shape and surface coverage of Au particles control the electrocatalytic performance. The reduction of oxygen follows a 2-step 2-electron pathway. The electrocatalytic performance of leaf-like particles is significantly high with respect to the other Au particles.

***Keywords**:* Disproportionation; Au nanoparticles; Electrocatalysis; Electroanalysis.

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