Abstract

Synthesis of functional Au and Ag nanoparticles of various shapes by chemical and photochemical routes and their analytical and bioanalytical applications are described. The photochemical synthesis of Au and Ag nanoparticles involves the reduction of metal precursor by eco-friendly reagents. Ag nanoparticles of different shapes were obtained using enzyme co-factor reduced nicotinamide adenine dinucleotide and its model compound as reducing agent. The photochemically synthesized Ag nanostructures of spherical, polyhedral, and triangular shapes have been used for the optical sensing of environmentally hazardous Hg(II) ions and H_2O_2, and antimicrobial activity studies. The thermodynamically favorable oxidative etching reaction of Ag nanoparticles with Hg(II) and H_2O_2 induces color change due to shape transformation. The size and shape-dependent activity of Ag nanostructures towards optical sensing and antimicrobial activity has been demonstrated. The polyhedral nanoparticle shows high sensitivity towards Hg(II) whereas triangular nanoplate shows high sensitivity towards H_2O_2. In case of antimicrobial activity, the smallest nanoparticle (1.5 nm) shows high activity. The spherical/quasi-spherical Au nanoparticles were rationally functionalized with suitable recognition molecules such as 2,4,6-trinitrobenzenesulfonic acid, uracil-5-carboxylic acid, and 2-thiouracil for visual sensing applications. Colorimetric sensing of melamine in raw milk and uric acid in serum has been demonstrated with the rationally functionalized Au nanoparticles. High sensitivity and selectivity and low detection limit have been achieved. A new photochemical route for the synthesis of Au-poly(α-terthiophene) nanocomposite has been developed; electroanalysis of biomolecules such as uric acid, epinephrine, ascorbic acid, etc. has been demonstrated with the composite modified electrode. The electrode is highly sensitive towards hydrophobic analytes. Easy permeation and facile electron transfer have been achieved for the hydrophobic analytes. Slugish electron transfer for the oxidation of hydrophilic bioanalytes was observed. The selective permeation of hydrophobic analytes is ascribed to their favorable interaction with composite modified electrode.

Keywords: Au and Ag nanoparticles; Photochemical synthesis; Colorimetric assay; Rational functionalization; Antimicrobial activity; Electroanalysis.