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Controlled simple green synthesis of smaller sized aqueous quasi-spherical polymer-capped silver nanoparticles

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We herein report the controlled synthesis of highly monodispersed water soluble, stable, smaller sized starch and gelatin capped-silver nanoparticles (Ag-NPs), via an eco-friendly, completely green method in a natural polymeric media. The method involves the use of silver nitrate, polymer (starch and gelatin) and maltose as the silver precursor, stabilising agent and reducing agent respectively in aqueous solution without the use of any accelerator. By varying the reaction time, we monitored the optical and structural properties of the colloidal Ag-NPs. The nanoparticles were characterised using UV-vis absorption spectroscopy, X-ray diffraction (XRD), transmission electron spectroscopy (TEM), high resolution electron transmission microscopy (HRTEM), selected area electron diffraction (SAED) and energy dispersive spectroscopy (EDS). The absorption maxima of the as-synthesised materials at different reaction time showed characteristic silver surface plasmon resonance (SPR) peak. The TEM image at 1 h reaction time showed well-defined monodispersed, spherical particle in a self assembly neck-lace arrangement. The particles were in the range 1.8-6.3 nm with an average particle diameter of 3.70±0.99 nm. As the reaction time increased the particle size increased and started to decrease after 24 h. The average particle diameter of 3.24±0.99 nm was obtained at the end of the reaction. The mechanism for the controlled synthesis in this smaller sized range is discussed. The high resolution image confirmed the high crystallinity of all the materials while the X-ray diffractogram confirmed that, the obtained Ag-NPs are of face-centered cubic (fcc) crystalline structure. The as-synthesised were found to be very useful for colorimetric detection of hydrogen peroxide (H_2O_2) at lower concentration up to 10^{-10} M and for the reduction of 4-nitrophenol to 4-aminophenol. This synthesis offers a cleaner and greener method for the controlled synthesis of Ag-NPs without the use of any hazardous complexant or accelerator.

Biography

Samuel Oluwatobi Oluwafemi is a National Research Foundation (NRF), South Africa rated researcher at the Department of Applied Chemistry, University of Johannesburg. His research is in the broad area of nanotechnology and include green synthesis of semiconductor and metal nanomaterials for different applications which include but not limited to biological (Imaging, labeling, therapeutic), optical, environmental and water treatment. He has author and co-author many journal publications, book chapter and books. He is a reviewer for many international journals in the field of nanotechnology and has won many accolades both local and international.

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