Facile Synthesis of Ultra-High Concentration, Stable Aqueous-Phase Dispersions of Silver Nanoparticles and Their Catalytic Properties

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A simple, environmentally benign green synthetic route was developed for preparing uniform silver nanoparticles with small particle sizes of less than 10 nm at ultra-high concentrations, in which ascorbic acid was used to reduce silver nitrate to silver nanoparticles in the presence of polyethyleneimine (PEI) as a stabilizer. The synthesized silver nanoparticles were characterized using UV-Vis spectroscopy, infrared spectroscopy (FTIR), powder X-ray diffraction (XRD) and transmission electron microscopy (TEM). The highly concentrated (above 200 g L^{-1}) predominantly spherical mono dispersed 8.2 ± 1.6 nm sized silver nanoparticles were obtained for the first time using PEI and ascorbic acid in just 8 min at 90 °C, at least 10 - 250 fold more than the previous reported methods. The catalytic activity of silver nanoparticles was also explored in the catalytic reduction of 4-nitrophenol to 4-aminophenol by $NaBH_4$. The catalytic results indicated the rate constant (k) was 1.37 × 10^{-3} s^{-1}, and activity parameter κ (where, κ= k/m), was 1142 s^{-1} g^{-1} (m = 1.2 × 10^{-6} g), which is quite higher than the previously reported values.