

# The preparation of hydrophobic silver nanoparticles via solvent exchange method

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## Abstract

We have prepared hydrophobic silver nanoparticles capped by oleic acid via solvent exchange method.  $\text{AgNO}_3$  was reduced by  $\text{NaBH}_4$  to produce Ag nanoparticles in aqueous solution with various pH conditions and oleic acid as stabilizer. By the addition of  $\text{H}_3\text{PO}_4$ , the carboxylate group was converted to carboxylic acid, and this induced the reorientation of oleic acid, and provided hydrophobic silver nanoparticles. The oleic acid-capped silver nanoparticles were characterized by UV–vis spectrophotometer and Fourier transfer infrared spectrometer (FTIR). Spherical silver particles with uniform size of 8 nm were obtained from silver nitrate under basic aqueous solution.

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## 1. Introduction

In recent years, the interest in the synthesis and preparations of nanometer-sized metal nanoparticles in organic solvent has increased because of their potential application in the field of electronics and photonics due to their peculiar size-dependent optical and electronic properties [1–5]. A variety of methods have been used for the preparation of metal nanoparticles. Silver nanoparticles can be doped in sol–gel matrix by precipitation method with HCl as catalyst [6]. Metallic silver nanoparticles having diameters from 5 to 10 nm in supercritical  $\text{CO}_2$  were prepared using an optically transparent, water-in- $\text{CO}_2$  microemulsion [7]. Gold, nickel, and silver nanowires were prepared within a polycarbonate membrane template by a combination of electroplating and photolytic method [8]. Gold nanorods were prepared by organic solvent reduction [9]. The preparation of nanoparticles in organic solvent is generally based on the extraction of metal ions from the aqueous phase with phase transfer agent, and subsequent reduction in the organic phase in the presence of capping agents [10,11]. This method yields good control over the particle size and dispersity but very

little effect on controlling the shape of the particles [12]. Solvent exchange method has become one of the prominent synthetic roots of nanoparticles, which can provide an effective way to prepare uniform-sized nanoparticles in organic solvents [13,14]. In this study, we have prepared colloidal silver nanoparticles in cyclohexane by using solvent exchange method, and their conformation and size dependence on pH of the aqueous solution were investigated. The silver nanoparticles stabilized by the oleic acid were produced in aqueous phase by the reduction of silver nitrate, and transferred into organic solvent by the reorientation of oleic acid. The silver colloids were characterized by UV–vis spectroscopy, Fourier transform infrared spectroscopy (FTIR), transmission electron microscopy (TEM), and Turbiscan.

## 2. Experiment

### 2.1. Materials

Silver nitrate ( $\text{AgNO}_3$ ), sodium borohydride ( $\text{NaBH}_4$ ), oleic acid (9-octadecenoic acid), phosphoric acid ( $\text{H}_3\text{PO}_4$ ), sulfuric acid ( $\text{H}_2\text{SO}_4$ ), ammonium hydroxide ( $\text{NH}_4\text{OH}$ ), and cyclohexane were purchased from Aldrich and used without further purification. Double-distilled water was used when necessary.

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