Studying the effect of surfactant on particles of a silver complex and its corresponding oxide

Shohreh Bolourian Kashi[1], F. Manteghi[1*]

[1]Department of Chemistry, Iran University of Science and Technology, Narmak, 1684613114, Tehran, Iran

*f_manteghi@iust.ac.ir

Abstract

Surfactants are compounds that lower the surface tension between surfaces. They are usually organic compounds that are amphiphilic, able to control the size and morphology of nanoparticles. In this study, silver nitrate and oxalic acid are used to prepare an inorganic complex in the presence or absence of surfactant, CTAB. The main characterization methods were FTIR and SEM. It can be observed from SEM images that the synthesized complex have various particle sizes including nano sized particles by adding the surfactant. The prepared complex was calcinated to obtain the corresponding oxide, Ag_2O with different particle sizes and morphologies. The surfactant can effect on size and morphology of both silver complex and silver oxide.

Keywords: Silver Oxide, complex, Oxalic acid, CTAB

Introduction

Metal oxide nanoparticles show interesting changes in their optical, magnetic, electrical and catalytic properties accompanied by improved physical properties like mechanical hardness, thermal stability or chemical passivity.

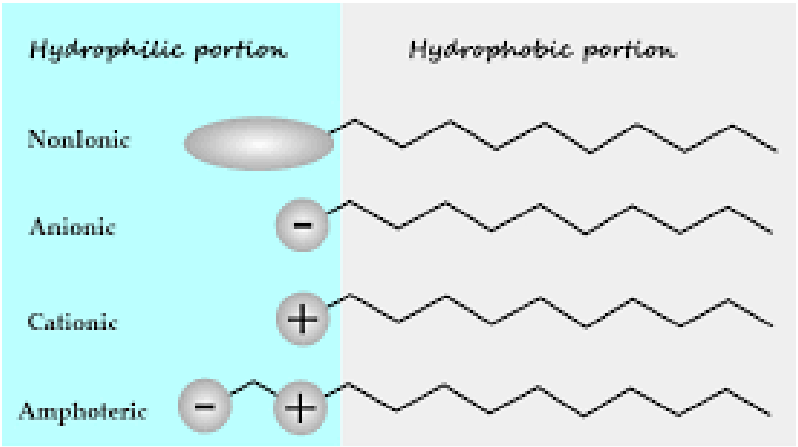

Fig. 1. Types of surfactants

The potential applications for nanostructured oxides include paint pigments, cosmetics, pharmaceuticals, medical diagnostics, catalysts, membranes, batteries, electronics, magnetic and optical devices, flat panel displays, biomaterials and protective coatings. CTAB is a cationic surfactant, shown in Fig. 1, and can control the morphology and sizes of particles during their formation process.

Methods and materials

All materials were purchased from Merck and used without further purification. The FTIR spectra were recorded on a Shimadzu-8400S spectrometer in the range of 400–4000 cm^{-1} using KBr pellets. Scanning electron microscopy (SEM) images were taken on a Philips XL-30 with gold coating.

Experimental

Oxalic acid and silver nirate were dissolved in ddw, seprately. Then they were added to each other while heating with molar ratio 1:2 ligand to metal. CTAB was added to the solution on heating until concentrating the solution and obtaining a grey precipitate. The product was washed with water and dried in air. Finally, the dry Powder was calcinated in 800° C with a slope of 10° C/min for 5h. The final product was a black powder.

Results and discussion

The FTIR spectrum of the silver oxalate complex is shown in Fig. 2. All the peaks are compatible with functional groups of oxalate. In particular, the ~3000 cm^{-1} peak is for water molecules present in the powder of complex. The peak at 1585 and 1305 cm^{-1} are attributed to COO group. Also, the 520 cm^{-1} absorption is attributed to Ag-O bond.

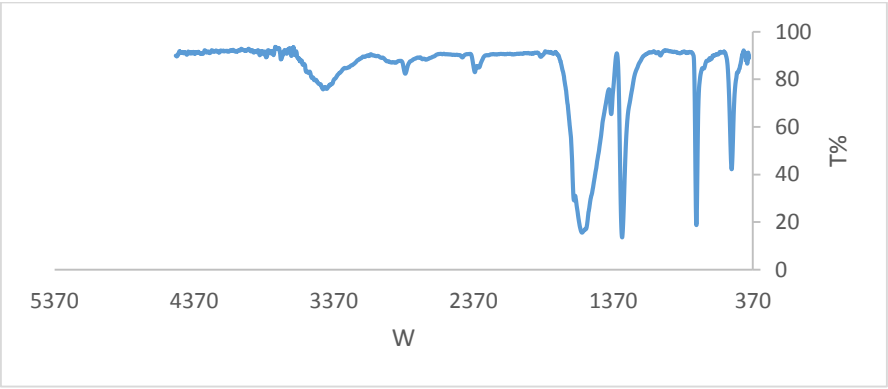

Fig. 2 FTIR spectrum of silver oxalate complex

Fig. 3 illustrates the XRD pattern of silver nitrate and nano silver oxide. All the peaks are independent. Fig. 4 shows the SEM images of silver complex and silver oxide. The complex is micro sized (0.85

μm) quasi-rhombohedral particles, but the oxide particles are nano sized (107 and 89 nm) agglomerated shapeless particles.

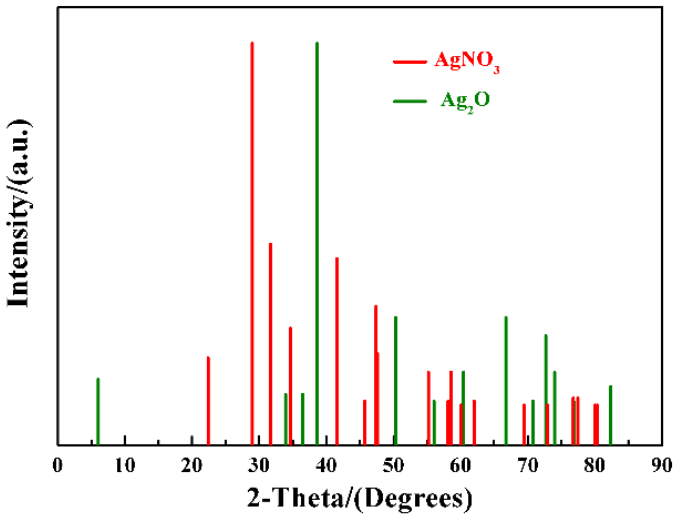

Fig. 3 XRD pattern of silver nitrate and silver oxide powder.

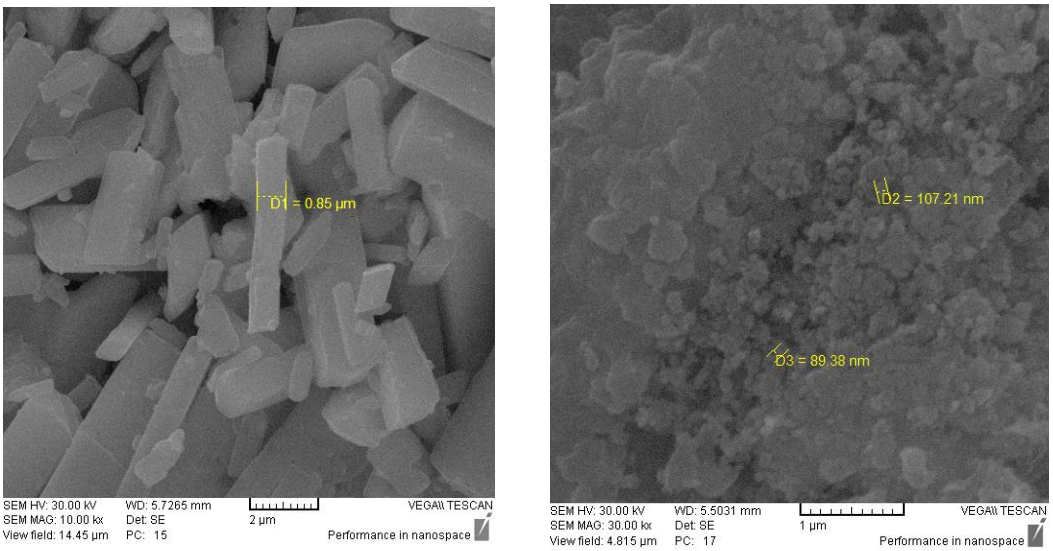

Fig. 4 (left) SEM image of as-sythesized Ag complex with CTAB. (right) SEM image of as-sythesized Ag_2O.

Conclusion

The silver oxalate and its corresponding oxide was synthesized. The presence of surfactant can effect only on shape of the complex and also, the size of oxide particles.

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