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Highly potential properties of Ag Nanostructures: Controlled Synthesis and Characterization

Nurul Akmal Che Lah* and Mohd Rafie Johan

(1) Advanced Materials Research Laboratory, Department of Mechanical Engineering, University of Malaya, 50603 Kuala Lumpur, Malaysia, e-mail: *umieakmal@um.edu.my and mrafiej@um.edu.my

* Corresponding author.

Abstract - The aim of this study is to obtain anisotropic and well dispersed shapes of silver (Ag) nanoparticles using controlled (isometric and anisotropic shapes) chemical reduction method. The characteristic absorption of Ag nanoparticles is approximately in the range of 420 – 450 nm (Fig.1). The spherical shape of Ag nanoparticles is observed at temperature of 80°C and the mean size is of approximately 5nm (Fig.2).

For the purpose, the experiments perform based on the combination factor design regarding some key factors involved in a general chemical reduction method. The optimum properties produced of Ag nanoparticles were governed by not only single or two prime factors but also interactions between them. In this controlled synthesis, the amounts of added chemicals and preparation conditions were varied. The presence of polyethylene glycol (PEG) as the reducing agent are described. Whereas the use of Daxad 19 in order to give better stable high concentration of Ag colloidal particles by prevention of particle interactions is introduced. Typically, 50 ml deionized water added into 100 ml beaker, maintained the temperature in the range of 78 - 80°C under magnetic stirring, dissolved 2.5 g of Daxad 19 as a stabilizer and then added 2 g of $AgNO_3$. To this solution, 4 g of PEG was added.

Relying on the experimental stipulations, Ag nanoparticles formed by directly or after the aging of reaction mixture for various period of time. By changing the amount of chemicals added, reactant temperatures, addition rates of reductant, and the aging time, particles of different structures were formed. Our observation can are agreement with the Lee et al. [1] statement where the reduction of silver nitrate with suitable reducing agent can lead not only to uniform, highly dispersed spheres in concentrated solutions, but also to isolated particles of other shapes.

The nanoparticles prepared were characterized by TEM, SEM and UV- vis absorbance for particle size, distribution, aggregation and anisotropy. The appropriate combination of the factors led to synthesize of varying in particle shapes, narrow distributed and non- aggregated of Ag nanoparticles. The sharp vertices of the elongated and hexagonal structures of Ag nanoparticles is expected to have optimum potential for enhancing the detection efficiency of SERS substrates and in current developing trends of the synthetic technology of Ag nanoparticles are also prospected.

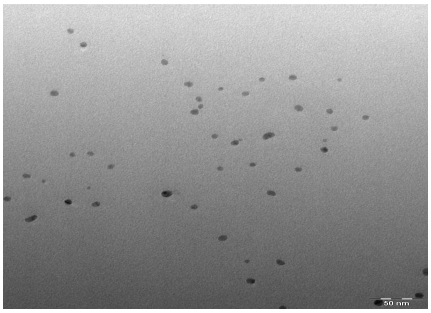

Figure 1: TEM micrograph of Ag nanoparticles obtain at temperature of 80°C.

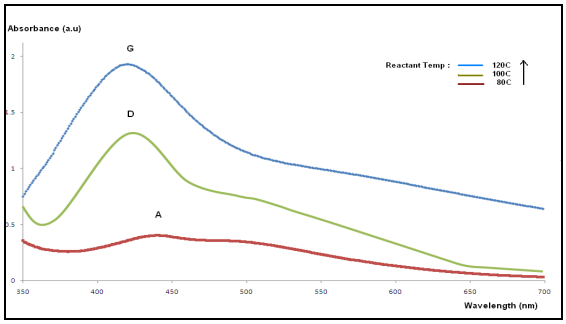

Figure 2: UV-vis absorbance spectra of Ag nanoparticles obtained at same concentration but different reactant temperatures.

[1] M.-H. Lee, S.-G. Oh, K.-D. Suh. D.-G. Kim, D. Sohn, Colloids Surf. A 210 (2002) 49.