11th International Conference
on Advanced Materials

Rio de Janeiro Brazil
September 20 - 25

ICAM2009

Ammonia as Moderator Agent for Growth Kinetics of Stable Colloidal Silver Nanoparticles Obtained by the Turkevitch Method.

L. F. Gorup(1)*, E. R. Leite(1), E. Longo(2), E. R. Camargo(1)

(1) Interdisciplinary Laboratory of Electrochemistry and Ceramics, Department of Chemistry, Federal University of São Carlos, SP, Brazil, e-mail : luizfernandogorup@gmail.com
(2) Department of Biochemistry, Chemistry Institute of Araraquara, UNESP,SP, Brazil
* Corresponding author.

Abstract – A new method to stabilize colloidal silver nanoparticles was proposed. Top-stability silver nanoparticles could be produced by Citrate method through ammonia addition to the colloid after the initial formation stage of nanoparticles. Ut was observed that ammonia plays an essential role in the stabilization of colloids at high temperatures. This moderator growth effect turns possible to stabilize nanoparticles preventing the coalescence disordered. The colloidal dispersions were characterized by UV-visible absorption spectroscopy, X-ray diffractometry and transmission electronic microscopy. The result shows that the morphology and size of nanoparticles in the different samples at room temperature have not changed in 15 months.

Considerable interest has been focused on the use of monodisperse metallic nanoparticles in colloidal state for several technological applications [1-2]. Particle size provides important influence over many of the physical and chemical properties of nanosized materials, including luminescence, conductivity, and catalytic activity [3-4]. The purpose of this work was to synthesize stable dispersions of silver nanoparticles using ammonia molecules as moderator agent of the particle growth kinetic. These nanoparticles were produced by the Turkevitch (also known as the citrate) method, by the addition of 3mM of sodium citrate into 1L with 1mM of $AgNO_3$. After the formation of the colloidal nanoparticles under heating, 1mL of ammonia (1.4 $mol.L^{-1}$) was added, and the reaction was followed by UV-visible spectroscopy The results indicated that spherical particles were first formed and are strongly stabilized by the presence of ammonia, preventing the disordered agglomeration. The particle size could be controlled through the time reaction. For instance, nanoparticles with 1.6nm were obtained with time reaction of 17 minutes and 2,2nm with 28 minutes. It was observed that size of the silver nanoparticles colloidal depends on several parameters, but can be efficiently controlled by some experimental variables, such as temperature, reaction time and presence of ammonia. Moreover, the ammonia showed to play a critical role in the stabilization of colloids at high temperature (near to water boiling). The addition of ammonia in the reaction after the nucleation stage provided the colloid stabilization. The moderator effect on the growth kinetics could be explained by the formation of layer on the surface of the nanoparticles, in substitution of the citrate ions. Ammonia molecules can be strongly coordinated in the surface of nanoparticles, creating a non-reactive barrier to attachment mechanism for the particle growth. The colloidal dispersions were characterized by UV-visible absorption spectroscopy, scanning electron microscopy, X-ray diffractometry and transmission electronic microscopy.

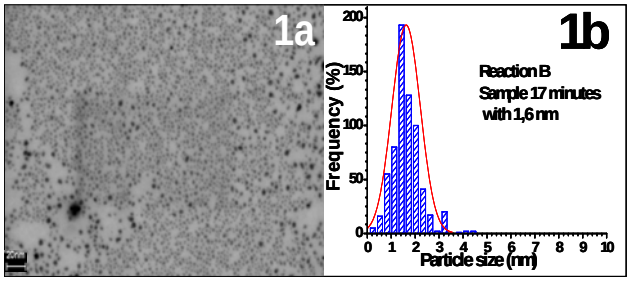

Figure 1: silver particle time reaction 17 minutes, **a)** TEM image of nanoparticles 1,6 nm **b)** results of histogram silver nanoparticles.

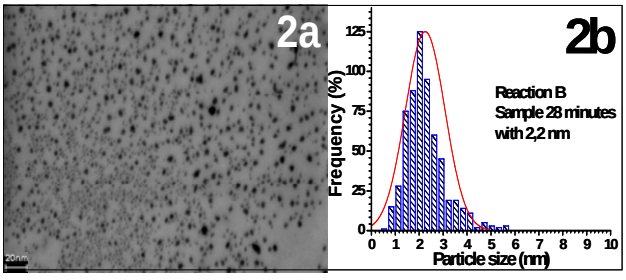

Figure 2: silver particle time reaction 28 minutes, **a)** TEM image of nanoparticles 2,2 nm **b)** results of histogram silver nanoparticles.

[1] M. M. Miranda , B. Pergolese, A. Bigotto, A. Giusti, J. Of Colloid And Interface Sci. 314 (2007) 540.
[2] I. Sondi, B. S. Sondi, Journal Of Colloid And Interface Science 275 (2004) 177.
[3] M.M.Oliveira, D.Ugarte, D.Zanchet, A.J.G.Zarbin, Campinas:Activity Report do LNLS, 345, 01 (2001).
[4] S.P.Zeena, V.K. Prshant, J. Phys. Chem. 108 (2004)945-951