Nano Innovation 2020 Conference & Exhibition — Rome, 15-18 September

Microwave-assisted synthesis of anisotropic silver nanoparticles

G. Lucchesi[1,2], S. Cicchi[1] and G. Caminati[1,2]

[1] Department of Chemistry, University of Florence, via della Lastruccia 3-13, 50019 Sesto Fiorentino, Italy

[2] Center for Colloid and Surface Science (CSGI), via della Lastruccia 3, 50019, Sesto Fiorentino, Italy

INTRODUCTION

In the present work we have attempted to produce irregularly shaped silver nanoparticles (AgNP) using a microwave assisted procedure with PVP as both reducing and capping agent in water solvent.

The fabrication of metal nanoparticles, including gold, silver, copper and platinum NP, has attracted a lot of interest in past decade. These nanoparticles, depending on their morphological and structural characteristics, have peculiar optical, mechanical and electrical properties that make them versatile in many fields of application. Many synthetic approaches have been proposed over the years, including microwave synthesis. This synthetic procedure allows to obtain homogeneous reaction temperatures throughout the sample and shorter synthesis time thus making the technique more eco-sustainable and also allowing to reduce production costs.

SYNTHESIS

In a typical experiment, silver nitrate and PVP water solutions were mixed together and irradiated in different experimental conditions.

Different samples were prepared varying the ratio PVP/$AgNO_3$ (R), the irradiation power (IP) and the time of irradiation (IT).

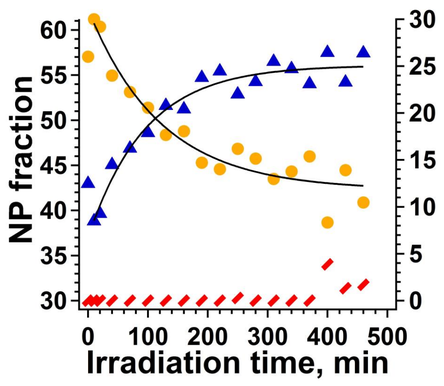
R = 4 – 30
IP = 50 W and 150 W
IT = 120 – 240 s

LIGHT INDUCED MODIFICATION

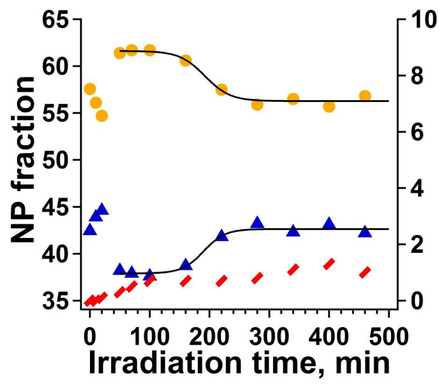
The light-induced morphology modification of the dispersions was monitored by means of UV-Visible spectroscopy.

UV (λ=365 nm) and tungsten lamps were used as irradiation light sources

UV lamp



Tungsten lamp



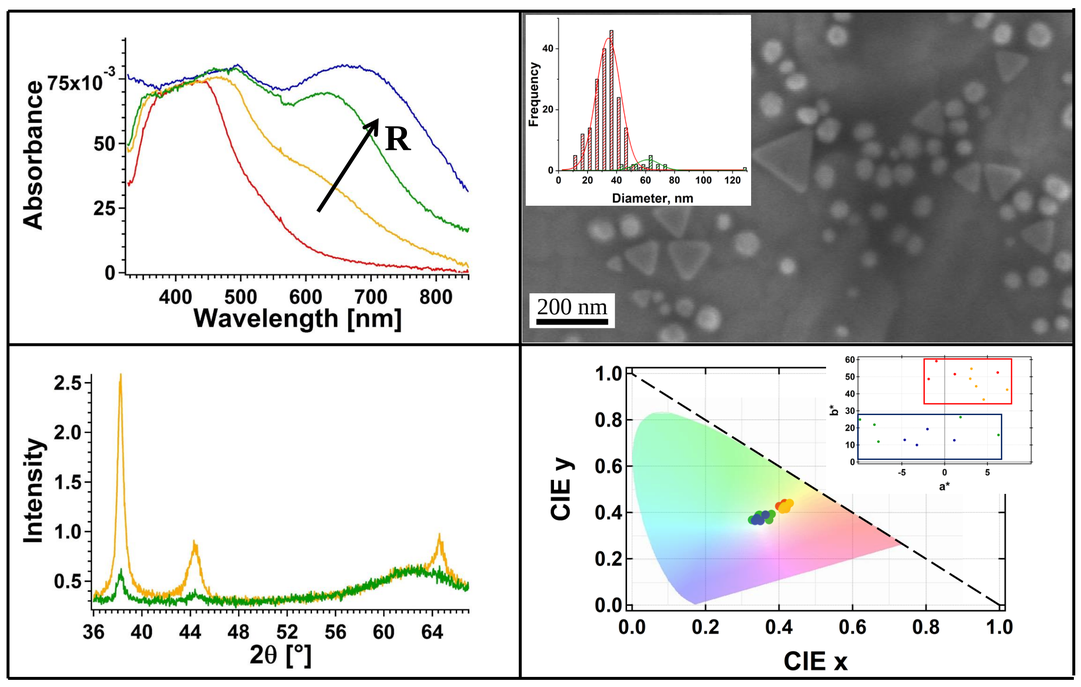
CHARACTERIZATION

Different techniques were employed to characterize the silver nanoparticles dispersions.

Both UV-Visible and SEM experiments shows the presence of two different populations of silver nanoparticles: triangular nanoplates (NPl) and nanospheres (NS)

XRD experiments reveal the presence of face centered cubic silver crystals.

CIE xyY graph shows two different groups that are related to the PVP content



CONCLUSIONS

- The ratio PVP/$AgNO_3$ modifies the yield of the reaction and the relative percentage between triangular nanoplates and nanospheres
- The triangular nanoplates have a mean edge lenght of 60 nm and the nanospheres have a mean diameter of 32 nm depending on the experimental conditions
- UV and visible light induce a morphology tranformation of the nanoparticles: they cause an increment in the triangular nanoplates fraction
- UV-Visible reflectance spectroscopy can rapidy discern different content of triangular nanoplates in the dispersions

References:

- Sun, Y.; Xia, Y. Shape-controlled synthesis of gold and silver nanoparticles. *Science* **2002**, *298*, 2176 – 2179

- An, J.; Tang, B.; Ning, X.; Zhou, J.; Xu, S.; Zhao, B.; Xu, W.; Corredor, C.; Lombardi, J. R. Photoiduced shape evolution: from triangular to hexagonal silver nanoplates, *J. Phys. Chem. C* **2007**, *111*, 18055 – 18059