Biological activity of glutathione-based silver nanoparticles

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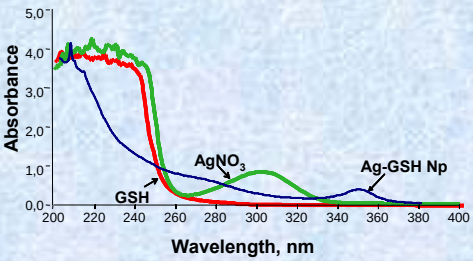
Herein we describe the preparation of glutathione (GSH) stabilized Ag nanoparticles (Ag Np) and their biological activity. Many chemical reduction methods have been used to synthesize Ag Np from silver salts [1-4]. The reaction described here uses silver nitrate as the starting material and sodium borohydride as reducing agent. The characterization of Ag Np and thiol-stabilized metal nanoparticles (GSH-Ag Np) was performed by FT-IR, UV-Vis, AFM and SEM techniques. GSH-Ag Np were biologically active at concentrations less than 10^{-5} M, whereas free Ag Np treatment with the same concentration was inoffensive. At 10^{-6} M concentration, Ag Np stimulated microorganisms growing, while 10^{-4} M and higher concentrations of these nanoparticles became increasingly more toxic.

Experimental

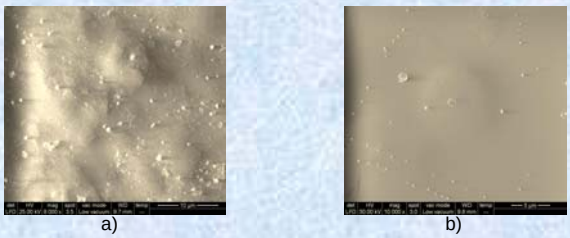
Reagents: silver nitrate, sodium borohidride, glutathione

UV-VIS Spectroscopy: LIBBRA S35 PC UV/VIS spectrophotometer



$AgNO_3$ (0.1 mM solution) was reduced with $NaBH_4$ (0.3 mM solution) in the presence or without glutathione (0.1 mM). The reaction took place at room temperature for 5 min under intense shaking, when the solutions became yellow in color.

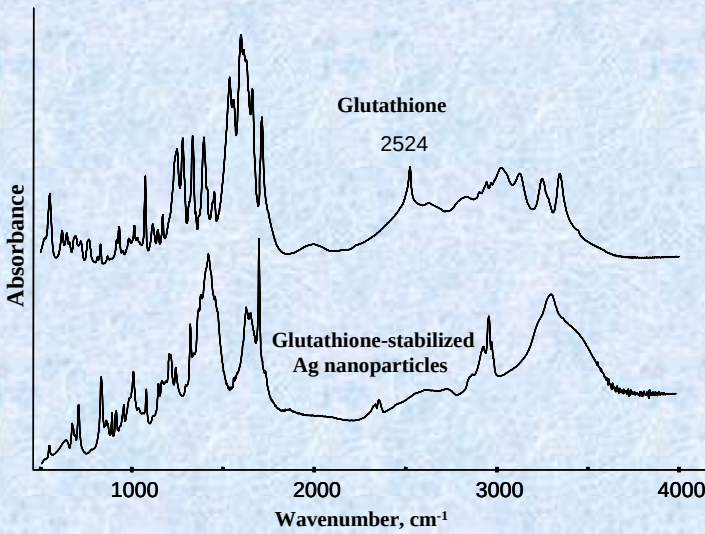
Scanning Electron Microscopy: Quanta 200 microscope, with elemental analysis system EDAX



a) b)

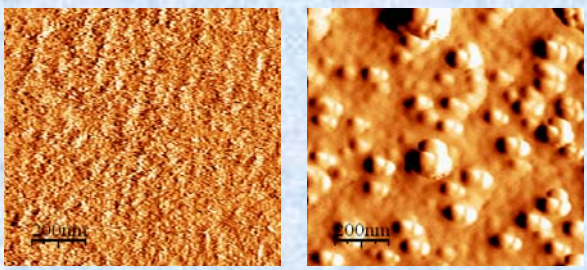
SEM images: a) Ag-nanoparticles; b) GSH-stabilized nanoparticles.

FT-IR Spectroscopy: Shimadzu Model 8400S FTIR spectrophotometer



Comparing the spectrum of pure GSH with that of GSH-Ag-Np was observed a significant change: group-SH of glutathione, which absorbs at 2524 cm^{-1} disappears from the spectrum of nanoparticles, and this shows the appearance of a S-Ag bond.

Atomic Force Microscopy: SPM Solver PRO-M AFM (NT-MTD Co. Zelenograd, Moscow), tapping mode.



a) b)

AFM images: a) glutathione; b) Ag-nanoparticles.

Morphological analysis of surfaces confirmed the formation of nanoparticles, which crowded when allowed to stay for 48 hours in aqueous suspensions, forming relatively large aggregates (20-150 nm) with different shapes.

References

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(3) Hasell T., Yang J., Wang W., Brown P. D., Howdle S. M., 2007, *Materials Letters* 61, 4906–4910.
(4) Solomon S. D., Bahadory M. A., Jeyarajasingam V., Rutkowsky S. A., Boritz C. 2007, *Journal of Chemical Education*, 84(2), 322-325.