PREPARATION AND SPECTROSCOPIC CHARACTERIZATION OF HEPARIN-REDUCED GOLD NANOPARTICLES AT ROOM TEMPERATURE

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Abstract

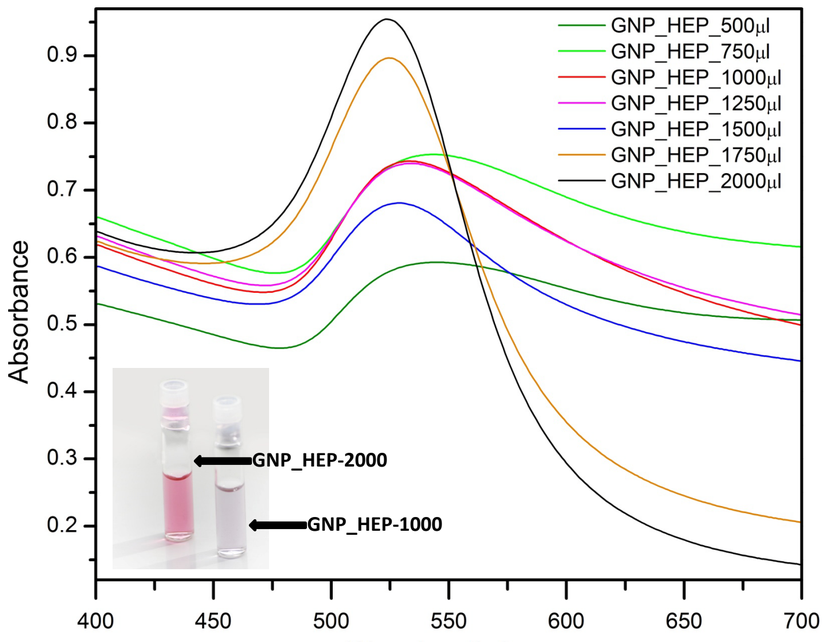
Recently, the application of metallic nanoparticles has shown promises in many research areas such as nanoelectronics, optical materials, biosensors, catalysis, and biomedical areas [1-2]. Gold nanoparticles have attracted researchers' attention for the targeted delivery of various therapeutic agents to cancer cells, which provides many opportunities in nanomedicine.

In this study a simple method for preparing gold nanoparticles in aqueous solution has been developed by using heparin sodium salt as reducing and stabilizing agent and $HAuCl_4$ as precursor. The obtained heparin reduced gold nanoparticles (GNP_HEP) were characterized by UV-Vis, FTIR and surface-enhanced Raman scattering (SERS) spectroscopy. The influence of reactant concentration on the preparation of gold nanoparticles was investigated. Their size and shape could be controlled by changing the concentration of the heparin. Moreover, the gold nanoparticles obtained with a relatively high concentration of heparin were very stable and had relative narrow size distribution.

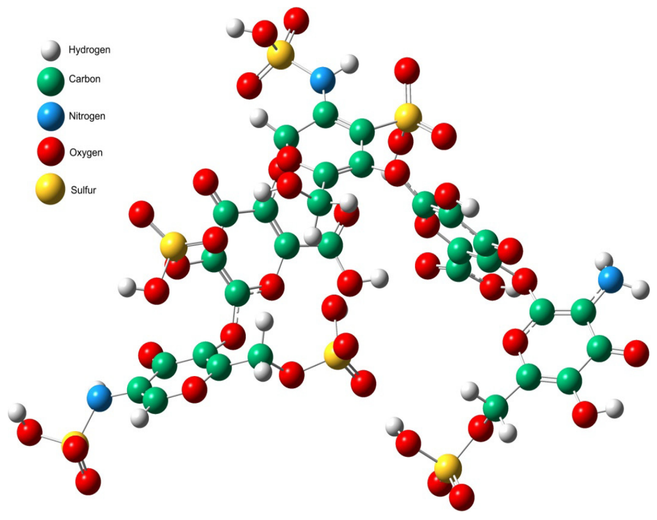
Methods

In a 100-mL round-bottom was added chloroauric acid (1g $HAuCl_4$ / 50mL H_2O , 100 µL) then, a solution of heparin (1%) was injected and stirred for about 100 minutes. All glassware used was cleaned in a bath of freshly prepared aqua regia solution ($HCl:HNO_3$ 3:1) and then rinsed thoroughly with H_2O prior to use.

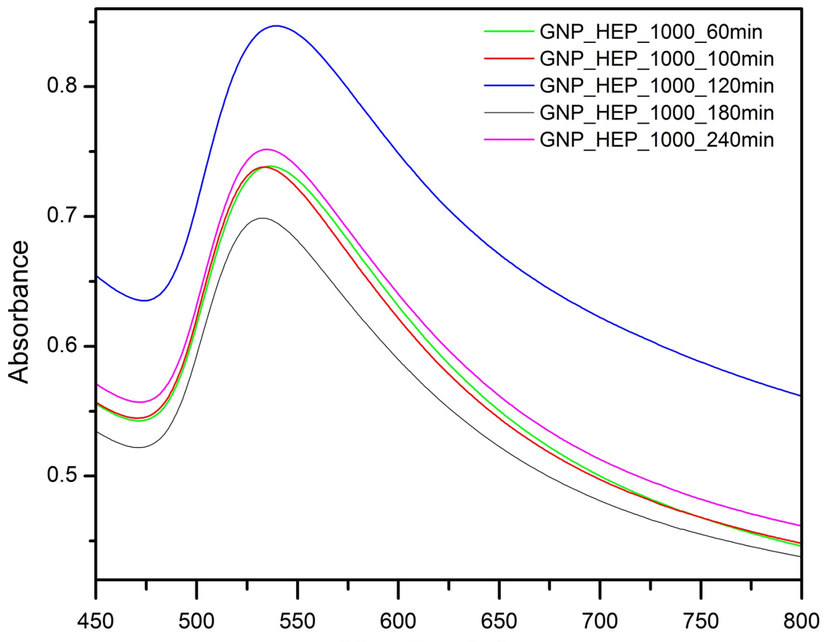
Results



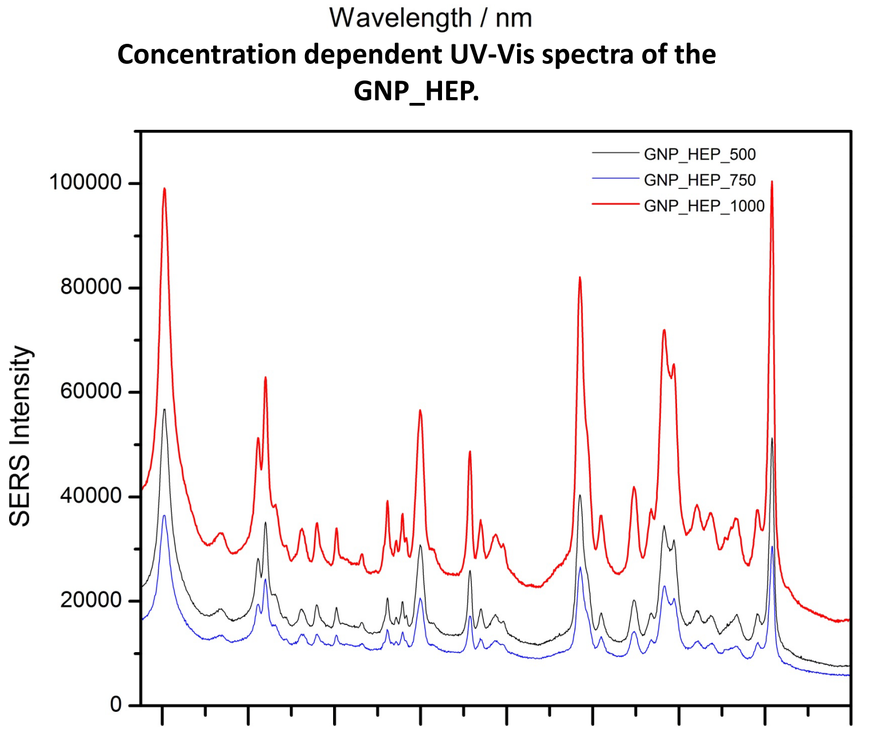
Concentration dependent UV-Vis spectra of the GNP_HEP.



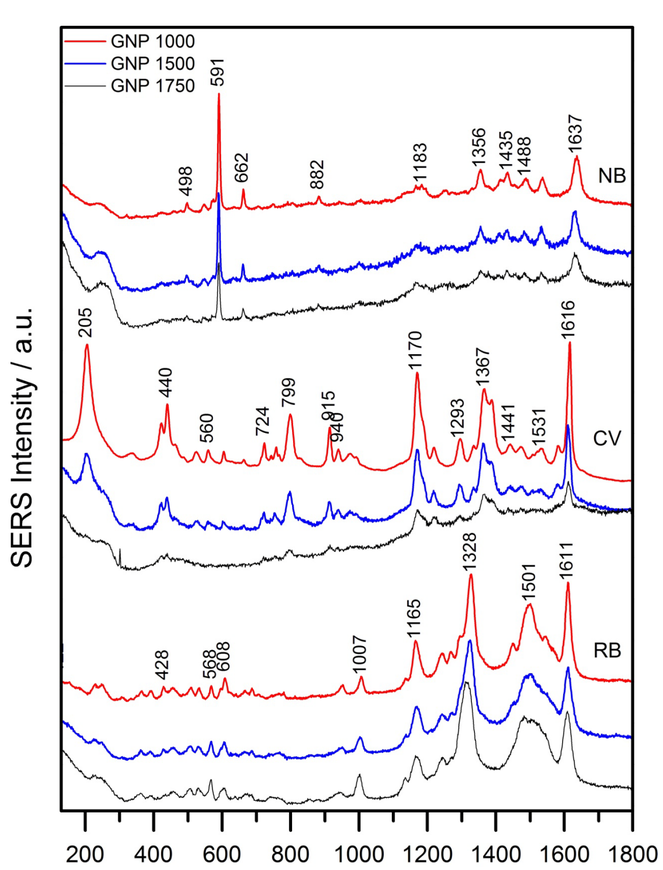
Chemical structure of heparin



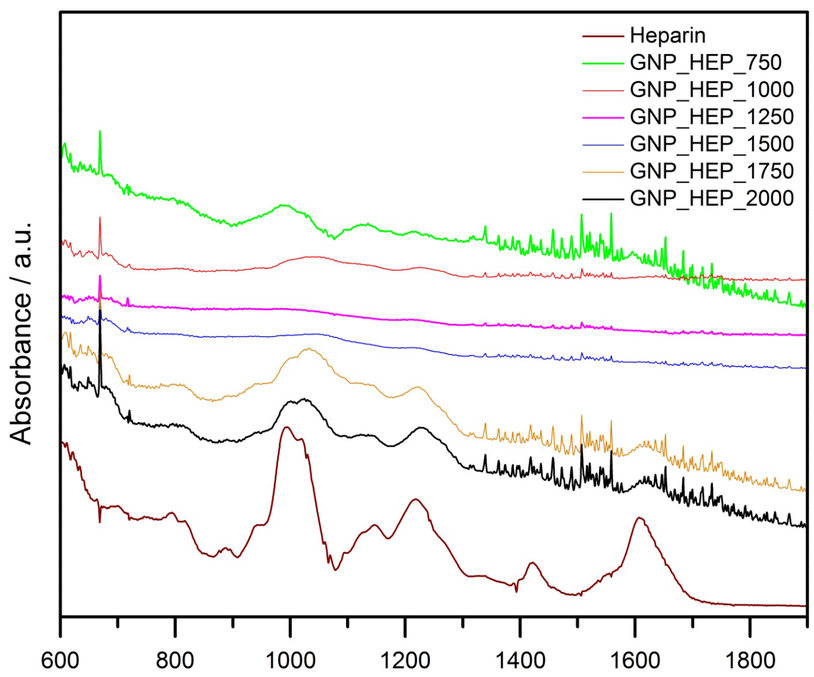
Time dependent UV-Vis spectra of the GNP_HEP_1000.



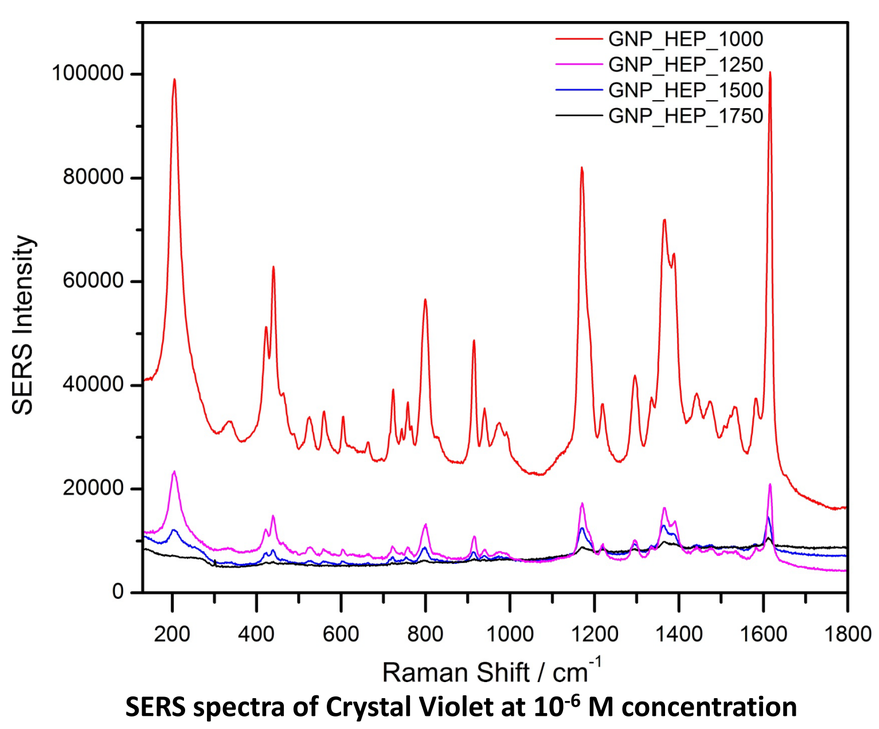
SERS spectra of Crystal Violet at 10^{-6} M concentration obtained with GNP_HEP_500-750-1000.



SERS spectra of Nile Blue (NB), Crystal Violet (CV) and Rose Bengal (RB) at 10^{-6} M concentration obtained with GNP_HEP_1000-1500-1750.



FTIR spectra of heparin and GNP_HEP reduced at different heparin concentration.



SERS spectra of Crystal Violet at 10^{-6} M concentration obtained with GNP_HEP_1000-1250-1500-1750.

Conclusions

For gold nanoparticles prepared with different concentrations of heparin the λ_{max} values have been observed in the range 524 to 543 nm, which are the typical plasmon resonance band for gold nanoparticles. From the UV-Vis spectra recorded at different times of reaction it can be concluded that 100 minutes is the best reaction time in order to obtain the most uniform GNP_HEP. Raman measurements revealed that GNP_HEP_1000 nanoparticles gives the most intense signals, in consequence these nanoparticles are the most suitable ones for SERS. The FTIR measurements shows that the heparin is present on the surface of the GNP_HEP. Taking into account the above mentioned results and the fact that the heparin is binding on thrombotic tissue our GNP_HEP are promissory for surface enhanced spatial offset Raman spectroscopy (SESORS) for monitoring thrombosis . As a next step, this GNP will be injected at different tissue depths to establish a detection limit using SESORS.

Acknowledgements

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References

[1] Park, Youmie; Im, A-Rang;Hong, Yoo Na; Kim, Chong-Kook; Kim, Yeong Shik, Journal of Nanoscience and Nanotechnology, 11(9), 2011, 7570.

[2] R. Arvizo, R. Bhattacharya, and P. Mukherjee, Expert. Opin. Drug. Deliv. 6, 2010, 7.

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