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GREEN SYNTHESIS OF Ag - Au NANOPARTICLES, ATTACHMENT ON THE SiO_2 MICROSPHERE SURFACE

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Abstract

Synthetic methods based on naturally occurring biomaterials provide an alternative, environmental-friendly means of obtaining nanoparticles. In this study, a simple environmentally friendly and cost effective method has been developed to synthesize Ag and Au nanoparticles. Reduction of gold and silver ions during the reactions was analyzed by UV spectroscopy. Silica- Metal (Ag,Au) particles were prepared by accumulating Ag, Au nanoparticles on the surface of APTMS functionalized silica as a substrate, which was accomplished strong interaction between metal and amino groups. Functionalized silica nanoparticles were initially decorated with Au and Ag metals. The morphology of resultant particles was studied using SEM. Presence of gold and silver particles on SiO2 sphere was confirmed by XRD, FTIR, TGA.
Key words: *Ag/Au nanoparticles, core-shell particle, biosynthesis*

Ag-Au NANOPARTİKÜLLERİNİN BİYOSENTEZİ, SiO_2 MİKROKÜRELERİN YÜZEYİNE BEZENMESİ

Özet

Nanopartikül elde etmede doğal olarak oluşan biyomalzeme dayalı sentetik yöntemler, alternatif, çevre dostu materyaller sağlar. Bu çalışmada, Ag ve Au nanoparçacık sentezlenmesi için basit, çevre dostu, maliyet az, etkili bir yöntem geliştirilmiştir. Reaksiyonları sırasında, altın ve gümüş iyonlarının indirgenmesi UV spektroskopi ile izlenmiştir. Silika- metal (Ag, Au) parçacıkları, yüzeyi APTMS ile fonksiyonlaştırılmış silikaya bezenmiştir. Elde edilen partiküllerin morfolojileri SEM kullanılarak incelenmiştir. Küresel SiO2 üzerindeki altın ve gümüş partiküllerinin varlığı XRD, FTIR, TGA ile de doğrulanmıştır..
Anahtar Kelimeler: Ag/Au nanopartiküller, core-shell yapılar, biyosentez

1 Introduction

Studies of the silica – metal core - shell particles are fascinating mainly because of their unique structures and interesting physicochemical properties, which make them attractive for a variety of applications [1]. Among all silica–metal core-shell particles, silver particles belong to the most popular ones, mostly because they can be synthesized by using various methods. Up to now,

a variety of techniques has been employed on the deposition of silver nanoparticles on silica spheres, including the inverse micelle method, sono-chemical synthesis and surface functionalization deposition. The above methods were time-consuming and carried out by using expensive instruments [2]. In this study, we describe a simple environmentally friendly, cost effective, and reproducible scalable method to prepare monodispersed metal-silica composite particles.

2 Materials and methods

The basic principle of this study, a single particle which brings together more than one material, it developed a variety of physical, chemical and biological properties to design particle systems show. While in the core-shell particles were synthesized in four steps.

In the first stage metal (Ag, Au,) particles were produced using plant bioextracts. Foeniculum vulgare, Rosmarinus officinalis, Thymus vulgaris are the most efficient agent in reduction. Water was used as solvent in the synthesis process. Reduction process of the metal salt at room temperature is easy and fairly quickly realized in sunlight. The reduced metal nanoparticles were characterized by uv–vis spectroscopy [3].

In the second stage, SiO2 microspheres were prepared from TEOS (Tetraethyl orthosilicate) according to Stöber process.

In the third stage, surface of silica was modified by APTMS (3-Amino propyl tri methoxy silane) at room temperature.

In the final stage, the metal particles (Au, Ag) were immobilized to the silica surface. The silica was modified by APTMS for immobilizing Au, Ag particles to the silica surface. The plant extract was used in different amounts. Microparticles (SiO2@Ag, Au) were analyzed by FTIR, TGA, XRD and SEM.

3 Results and discussions

Biosynthesis of metal nanoparticles were performed using *Foeniculum vulgare, Thymus serpyllum L., Rosmarinus officinaliserrestris extract*. The metal nanoparticles were characterized by uv–vis spectroscopy.

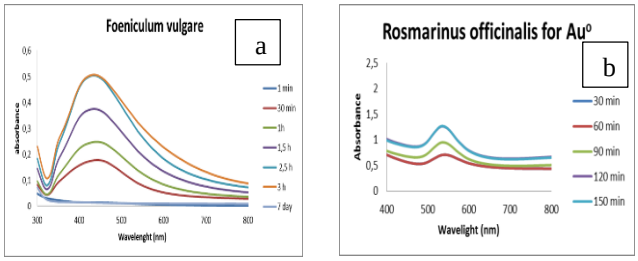

Figure 1. (a) UV–vis spectra of Ag nanoparticles SPR peak at 450 nm (b) Au nanoparticles SPR peak at 550 nm.

The monodisperse amorphous spherical SiO_2 cores with an average diameter 250 nm were synthesized by using the Stöber method. SEM images of SiO_2 particles when examined showed smooth, uniform, spherical shape. The size of the micro-particles, generally shows co-dimensional distribution.

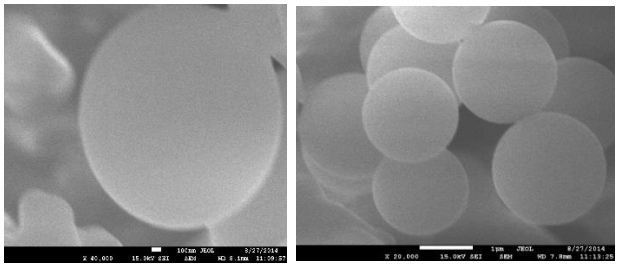

Figure 2. SEM micrographs: SiO_2.

The morpholgy of metal-decorated silica particles was characterized by SEM and the metal at the surface of the silica was determined by using XRD, TGA, EDS techniques.

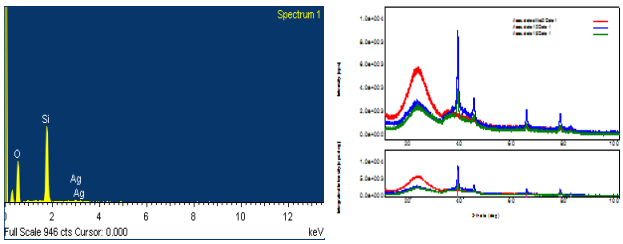

Figure 3. XRD and EDS spectrums of SiO_2@Ag.

SiO_2@Ag particles were dried to examine with XRD, as shown in Fig. 3. The five distinct characteristic peaks observed at 2Θ values of 22°, 38°, 42°, 64° 68° . SiO_2 peak (red line) appeared at 2Θ =22° and structure of silica was amorphous. The crystalline planes of the Ag 's structure (blue line) were observed at 38°, 42°, 64° 68°.

The EDS result of SiO_2@Ag spheres (Fig. 3) confirms that the existence of Ag, Si, O peaks come from the sample support. Si and O peaks result from the silica core. Fig. 4 shows the EDS spektrum of SiO_2@Au confirms the existence of Au, Si, O peaks, as well. From Fig. 4, it can be seen that the TGA curves of SiO_2@Au microspheres. The weight loss of pure SiO_2 (red) is 8 %. Nevertheless the weight loss of SiO_2@Au (blue) is 25 %. This difference confirms that the presence of SiO_2@Au particles.

From Fig.5, it can be seen SiO_2@Ag, Au particles. The decoration process have been successfully realized for Ag and Au

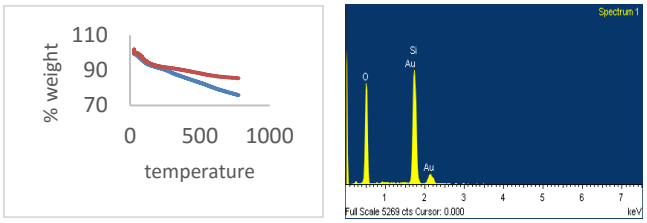

Figure 4. TGA curves of SiO_2@Au, EDS spectrum of SiO_2@Au.

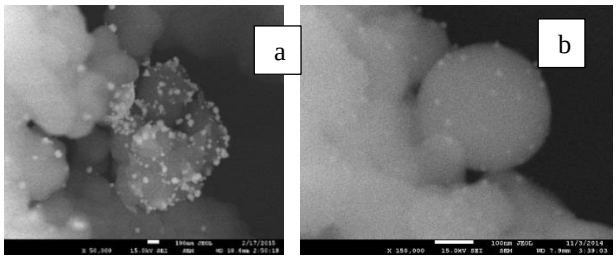

Figure 5. SEM micrographs: (a) SiO_2@Au (b) SiO_2@Ag.

The reduced gold nanoparticles decorated silica were characterized by FTIR (Fig.6). FTIR analysis of Au nanoparticles shows the presence of five bands at 1056, 1645, 2376, 2924 and 3453 cm^{-1}. OH stretch and because of the adsorbed water on the silica surface and broad absorption band at 3425-3450 cm^{-1} OH bending molecular water was observed that the peak of the 1640-1630 cm^{-1}. Si-O-Si asymmetric stretching was observed in 1110-1090 cm^{-1} .

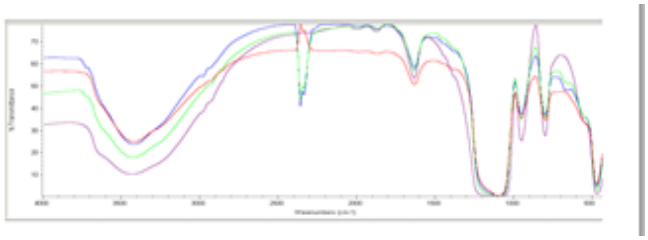

Figure 6. FTIR spectrum of SiO_2@Au core–shell particles.

4 Conclusion

In conclusion, environmentally friendly, cost effective and spherical SiO_2 @Au, Ag particles were obtained. Plant extracts are used in the preparation of metal nanoparticles. All operations are carried out in accordance with the principles of green chemistry.

5 Acknowledgment

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6 References

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