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Research Article

INTERACTION OF MAGNETIC IRON OXIDE CORE/ ZNS SHELL NANOPARTICLES WITH METFORMINAND CALCULATION OF THERMODYNAMIC FUNCTIONS

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ABSTRACT
In this research, the magnetic iron oxide core/ ZnS shell nanoparticles were prepared by in alkaline medium. One kinds of surfactant was used in the synthesis. Magnetic iron oxide core/ ZnS shell nanoparticles were coated with sodium citrate and metformin. Characteristics of coated magnetic nanoparticles and no coated were carried out using scanning electron microscopy, X-ray diffraction and FT-IR spectroscopy.

Keywords: *Magnetic Iron Oxide, Core/ Shell Nanoparticles, Zns*

INTRODUCTION
In the past decade or so, core-shell structured nanoparticles have been receiving growing research attention, due to their enhanced or combined optical, electronic, and magnetic properties compared to the single-component nanomaterials (Sounderya *et al.*, 2008). Interests in nanocomposites of this kind originate not only from the curiosities of scientities who are exploring the mesoscopic world, but also from the ever increasing demands placed on materials synthesis performance by nanotechnology (Bhattacharjee *et al.*, 2006). Although much progress has been made in syntheses of core/shell nanoparticles (Brian and Robert, 2003). In a recent report, we described the synthesis of magnetic nanoparticles iron oxide/ZnS core-shell nanoparticles and then interaction with metformin. Scan electron microscopy (SEM) shows whether a particle of ZnS character contains a magnetic core or not (Zaidul *et al.*, 2007).

Experimental
Analytical Approaches and Methods

The reagents used for chemical synthesis γ- Fe_2O_3 nanoparticles and ZnS nanoparticles $FeCl_3.6H_2O$, $FeSO_4.7H_2O$, urea, NaOH, $ZnCl_2$, and Na2S and are prepared by using double distilled water. The wet chemical synthesis of γ- Fe_2O_3 nanoparticles was based on hydrolysis of Fe^{3+} and Fe^{2+} salt in the presence of urea and NaOH with the following ultrasonic treatment of FeO (OH)/ Fe $(OH)_2$ in the sealed flask at 30°C35°C for 10 min30 min in order to enhance interaction between the hydrolysis products. After aging for 5h the obtained black powder was washed and dried.
The Fe_3O_4/ZnS core-shell nanoparticles reaction with metformin in an alkaline medium and the data from a UV-vis absorbance spectrophotometer at 23°C, 33°Cand 43°C was studied. Spectral data may be analyzed to extract the balance temperature constant. This was done on the basis of the algorithm of the SQUAD software and the standard enthalpy of the process of metformin adhesion on Fe_3O_4/ZnS core-shell nanoparticles may be calculated using logK changes with 1/T. Thermodynamic analysis of the process is made in terms of Gibbs free energy changes ΔG°, enthalpy changes ΔH° and entropy changes ΔS°. The free energy changes of the process is expressed by ΔG°= -RlnK, where R = universal gas constant and K= Kelvin absolute temperature.

RESULTS AND DISCUSSION
Results
The results are shown in Table 1 and Figure 3. Calcination of the prepared Fe_3O_4 powder in air temperature 180°C to 210°C led with formation of γ-Fe_2O_3 nanoparticles. The surface modification of magnetic nanoparticles (MNPs) was carried out by the reaction of NPs with sodium citrate. The mixture

was kept under ultrasonic, and then stirred for 2h at temperature of 60 under Ar protection. The precipitate washed with acetone for several time.

For synthesis of ZnS nanoparticles Mercaptoethanol is used as the capping agent. A three neck reaction flask is used as reaction chamber and reaction take placed under N_2 inert gas to prevent any oxidation effect while reaction is going on. For synthesis of Fe_2O_3/ZnS core/shell MNPs, the sodium citrate modified Fe_2O_3 MNPs were re-dispersed in 100 ml deionized water and was kept under ultrasonic for 30 min, then some of former solution was added into a three-neck flask and the coating experiment was conducted according to the process product of ZnS nanoparticles.

Table 1: Thermodynamic parameters of binding of core shellnano particles with Metformin in pH=12

T K	Log K	ΔH kJmol^{-1}	ΔG kJmol^{-1}	ΔS JK^{-1} mol^{-1}
296.15	7.39	9.31	18.19	28.99
306.15	7.27	9.31	18.50	29.98
316.15	7.15	9.31	18.79	30.01

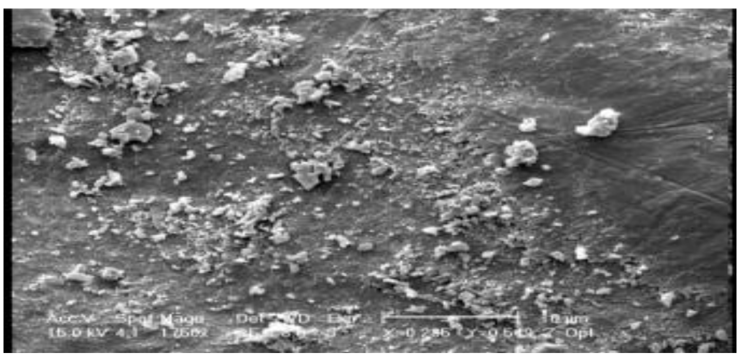

Figure 1: The SEM image of sodium citrate modified Fe_2O_3 nanoparticles coated by ZnS nanoparticles

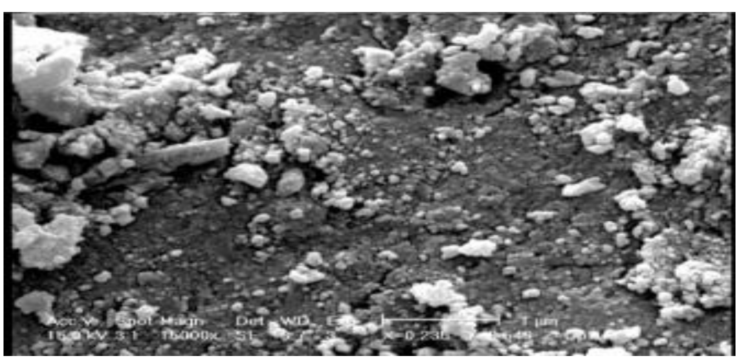

Figure 2: The SEM image of Fe_2O_3 /ZnS core/shell nanoparticles are coated with Metformin

Preparation of Magnetic Iron Oxide Core ZnS Shell Nanoparticles with Metformin:
1 g metformin, which was dissolved in 20 mL water, was added to magnetic iron oxide core/ ZnS shell nanoparticles under the nitrogen gas. Then the reaction mixture was sonicated (using an Aquasonic ultrasonic cleaner) for 2.5 h. Excess metformin was removed by ultracentrifugation at 15 000 rpm for 30 min.

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The SEM photographs of sodium citrate modified Fe_2O_3 nanoparticles coated by ZnS nanoparticles are shown in Figure 1 and Figure 2 before and after coated with Metformin respectively. The SEM photograph illustrated that the Fe_2O_3/ZnS core/shell MNPs was <100 nm. This can be explained by the fact sodium citrate modified Fe_2O_3 MNPs have smaller particle size and better dispersibility, which provided the Fe_2O_3 MNPs with larger specific surface area and surface energy.

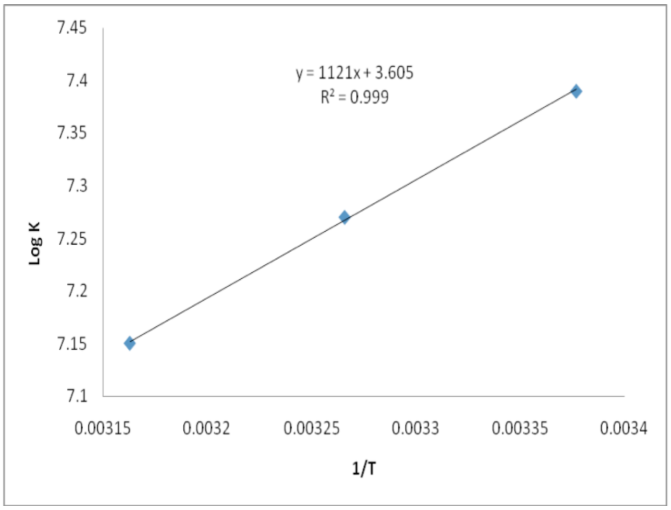

Figure 3: The thermodynamic analysis of core-shell nanoparticles (Fe_2O_3/ZnS) and Metformin in pH=12

The Data from the process of metformin absorption on iron oxide core-shell nanoparticles in an alkaline pH are shown in Table 2.

Table 2: Absorbed Metformin on core/shell in pH=12 and 230 nm

t^oC	Absorbed Metformin on core/shell
23	0.225
33	0.213
43	0.200

Discussion

The Fe_2O_3 MNPs which were treated by sodium citrate, showed better dispersion and could be coated by ZnS uniformly.The Fe_2O_3/ ZnS core/shell composite MNPs also showed better dispersion than the untreated Fe_2O_3 MNPs.Data from the process of metformin absorption on iron oxide core-shell nanoparticles in an alkaline pH shows that as temperature increases the rate of metformin absorption on nanoparticles surface decreases and according to Van't Hoff equation and enthalpy it is proved that metformin core-shell nanoparticle reaction is exothermic.

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