Poster

SYNTHESIS AND CHARACTERIZATION OF MAGNETIC NANOPARTICLES AND FUNCIONALIZATION WITH DIFFERENT ORGANIC MOLECULES

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Summary

In the current communication we present the preliminary results of a research work in the synthesis and biofunctionalization of magnetic particles. We describe the magnetic material synthesized and the methods and substances for its functionalization.

Introduction

In this experience we have synthesized nanoparticles of Magnetite (Fe_3O_4) starting from Iron Chlorides by the Massart method; making a dilution in aqueous media. With this dilution we have prepared, in one hand, a magnetic ferrofluid, that has been functionalized in two different ways. On the other hand we have used the dilution for preparing a colloidal gel for further applications in surfaces.

In last term we have characterized every synthesized product by different ways, the magnetic properties have been studied with a magnetometer, the structure of aggregates has been analyzed by FTIR, ESR(NMR) and SEM/TEM, and the optical properties of the samples has been analyzed by UV-vis spectrophotometry.

The biofunctionalization of magnetite nanoparticles has been made not only in order to turn them “bio-friendly”, but also for a possible application in selective bonding to some kind of biomolecules, such antibodies, amino acids, proteins, etc.

Experimental and Results

The magnetite nanoparticles were made by co precipitation of Iron chlorides. This is obtained by the neutralization of an acidic dilution of these chlorides in HCl with ammonia[1,2]. After that, we proceed in many ways: the magnetite is dispersed in a colloidal solution in water, so that it can be precipitated by adding a surfactant (like tetramethil-hidroxyammonium) or it is possible to bound it with some kind of molecules of interest[4,5,6]. In this essay we have tried this with three different organic substances:

1. Polyethylene Glycol (PEG 600): a biocompatible polymer, the base of numerous pharmacy products for topic administration, and cosmetic creams. The treatment of the samples was as follows: after the magnetite and ferrofluid synthesis, the PEG was added to the compound in a molar ratio equal to the Magnetite’s one. At the second time the sample was put in the shaker for an hour at RT, to favor bonding.
2. APTS: Aminopropil- triethoxysylane. An organic molecule with an amino-terminal ending. Is a good candidate selective bonding for molecules with a carboxylic ending such as single amino acids or peptides. The synthesis of these samples was similar that PEG one’s.
3. Triethylethoxysilane-PEG: The co precipitation of these compounds causes the generation of Polyethylene glycol-coated Silica nanoparticles. For our purposes, we have made this synthesis adding the magnetite’s particles, to give them magnetic properties, as follows: for a 100ml total volume we must start, in a basic pH solution 0.2 M of ammonia, adding PEG-600, for a 0.2M total concentration, next we add Ethanol to complete the solution’s volume. The next step is add the magnetite (0.2 M),

and finally the TEOS (0.2 M). The solution forms a thick, milky browned liquid that contains the nanoparticles synthesized.

After that, we have proceed to characterize the magnetical, chemical and structural properties of the resulting compounds.

In order to determine the mean size and dispersion of the particles we have observed them by Transmission and Scan Electron Microscopy. In one hand the particles from the aqueous dispersion (dehydrated), and in the other hand the functionalized particles by the different methods (dehydrated too).

For the study of the functionalization, besides the TEM/SEM observation we have made FTIR measures in order to determine the magnetite-biomolecule bonding and the formation of clusters or binds.

The magnetic properties of the different compounds have been determined by the measurement with a magnetometer.

The UV-vis measures in transmission mode, show us the absorbance of the compounds synthetized, versus the single ones' by comparing their spectrum and infer possible molecular interactions between the organic molecules and the magnetite.

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