Synthesis and Characterization of Surface Modified Magnetic Hollow Silica Nanospheres

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Targeted drug delivery with release on demand property is a very promising concept of treating various illnesses (cancer, cardiovascular diseases or diabetes) in the future. Modified holow mesoporous silica nanoparticles could serve as a delivery vessels of an active substance in this method and could find a wide range of applications in industry as well. The particles could be either autonomous or serve as an inner compartment of larger and much more complex chemical robots.

The goal was to prepare surface modified hollow porous magnetic silica nanoparticles (100 – 300 nm) with composite iron oxide. The final particle should have properties of a living organism except the ability of reproduction and evolution. That means it is capable of movement in the surrounding environment, material exchange and controled accumulation or release of substances. For the synthesis of the nanoparticles we used an emulsification method. We mixed 0.282 g of oleic acid (1 mmol) in aqueous ethanol solution (50 mmol of EtOH and 1600 mmol of water) at room temperature. Under constant stirring 0.221 g of (3-aminopropyl)ethoxysilane (1 mmol) and 1.4 g of tetraethoxysilane (6.4 mmol) was added to the mixture. After 10 minutes the stirring was stopped, the mixture was left at room temperature for 2 hours and than was being heated to 80 °C for another 24 hours. An electrostatic bonding method was used to prepare nanoparticles with surface modified by iron oxide. For this, iron oxide nanoparticles with positive surface charge had to be prepared and they were mixed with silica nanoparticles, which have negative surface charge. Characterisation of properties of the resulting nanoparticles was done by transmission electron microscopy (TEM), dynamic light scattering (DLS), electrophoretic light scattering (ELS), electro-magnetic heating, Brunauer-Emmett-Teller (BET) surface area analysis with pore size analysis and finally release kinetics of a model substance was measured.

Keywords: composite nanoparticles, nanoparticles, silica, iron oxide, triggered release, radiofrequency heating