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CHARLES UNIVERSITY IN PRAGUE,
FACULTY OF SCIENCE
DEPARTMENT OF INORGANIC CHEMISTRY

Ref : **Ph.D. Thesis of Anton Repko**
Study program: Inorganic Chemistry
Preparation of magnetic nanoparticles by hydrothermal method

TO WHOM IT MAY CONCERN:

Magnetic nanoparticles exhibit a dramatic change of properties when the dimensions are reduced to the nanoscale range. That reduction in size is responsible for new magnetic properties which are determined by chemical composition, crystal structure, particle size and shape, magnetic interactions between particles and with the surrounding matrix. This justifies the importance of the nanoparticle size, shape and structural homogeneity and the preparation reproducibility. Those systems have an enormous economic relevance in view of the new magnetic properties and the increasing number of new applications.

In particular, the application of nanotechnology in healthcare offers numerous very promising possibilities to significantly improve medical diagnosis and therapy. At the same time, nanomedicine is a strategic issue for the sustainable competitiveness of Europe. This subject follows the lines established by the EU within the "Horizon 2020" program, supporting the development in Key Enabling Technologies (KETs) covering areas such as Nanotechnologies, Advanced materials, Advanced manufacturing and processing and Biotechnology. For example, drug delivery systems offer the possibility of improving efficiency in diagnosis and treatment but a synergistic effort is required between the development of nanotechnology for diagnosis and research towards finding effective therapy.

This work offers an interesting study comprising from synthesis to structural and magnetic characterization of magnetic nanoparticles, in particular cobalt ferrite prepared by the hydrothermal method. This is an interesting alternative route to conventional and more complicated synthesis methods which is recently receiving increasing attention because of the interesting results. Synthesis parameters have been analysed in this work to optimize the particle size and the structural, colloidal and magnetic properties. The results presented here have shed some light on the mechanism of particle formation which allows the particle size control and the increase of the reaction yield.

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The manuscript consists of a first part where basic concepts on magnetism are discussed, then a deep bibliography search on the use of magnetic nanoparticles is included and finally, there is a description of two characterisation techniques, X-ray diffraction and Mossbauer spectroscopy. The results are collected in the fourth chapter that contains three papers describing the synthesis of the particles, the colloidal properties and the magnetic behaviour before and after surface modification to make them hydrophilic. The sizes have been varied between 6 and 11 nm and up to 500 mg were obtained per batch. Surface modification was carried out by coating with carboxylic acids, dextran and titanium dioxide to stabilize the particles in water.

The results presented here meet the academic standard requirement for a PhD degree. The candidate shows good knowledge on the field to which his research relates, he has applied an appropriate research method to try to solve a current problem and he understands the techniques to interpret the results. The candidate has also done an important effort in terms of bibliography and the presentation of the work that is clear and easy to follow.

Some remarks to be discussed during the defense:

- Main parameters affecting or limiting particle size in samples prepared by the hydrothermal method.
- Future work to increase particle size up to 20 nm.
- Comparison with commercial samples.
- Co ions distribution in the spinel structure: effect on the magnetic anisotropy.
- Magnetic particle interactions effect on the performance of this material for biomedical applications.
- Origin of the magnetic spin canting: the role of the coating.
- Mössbauer spectroscopy applied to distinguish between internal and surface spin canting.

Should you require any further information, please do not hesitate to contact me.

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