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Opponent's opinion of the Doctoral thesis:

„Optimization of Magnetic Nanopartciles for Hyperthermia in Viscous Environments“

author: Mgr. Tereza Sojková

The presented doctoral thesis is devoted to the highly topical medical and social issue of the possibility of preparation of magnetic nanoparticles with application in hyperthermia. The proposed topic, by its very nature, provides the prerequisite for being desired preparation of the doctoral student in the way of mastering advanced material preparation, learning non-trivial methods of material investigation, also in material development, which is very important. The work is divided into three main parts. The theoretical part describes nature of iron oxide nanoparticles with respect to their surface modification, also it provides an extended overview of their biomedical applications. Special part is devoted to the overview of the most common methods of synthesis of magnetic nanoparticles. The middle-experimental part provides details on synthesis of magnetic nanoparticles investigated in this work. The experimental part is clear and gives protocols for synthesis of iron containing nanoparticles of different structures, composition and morphology. In the experimental part, The author clearly demonstrated that has all the prerequisites to cope with the production of the defined material and optimize the parameters to achieve the goal of their producing. The main part-Results and discussion gives detailed study on structure and physical properties of synthesized nanoparticles. It is evident, that PhD student has particular knowledge to formulate logic connections between structure/morphology of synthesized materials and observed physical/magnetic properties. The author also presented several physico-analytical experiments using different techniques, which predisposes the author to a broad view of the structure and properties of the material. The theoretical background and conclusions are

confirmed by very detailed literature review with more than 122 sources. Nevertheless, it might be useful to summarizes knowledge of the properties of individual synthesized materials from the literature, which might be appropriate to insert into a graph/table and thus insert the point that we need to work towards in order for magnetic nanoparticles to have an effective impact on practical applications. The work is written clearly and comprehensibly in English. Thesis has all formal qualities.

Opponent's formal comments:

1. The doctoral thesis contains minimum formal mistakes.

2. Page 35: the XRD does not belong to the spectroscopy methods

3. I recommend to enlarge scale on TEM micrographs to be better visible.

Opponent's questions:

1. As mentioned above, in the proposed work several sophisticated physico-analytical characterization techniques were used. Could you specify, which of them were performed by your own?

2. Crystallite size in synthesized magnetic nanoparticles was determined by Rietveld refinement (e.g. Tabs. 6-10). Could you specify method of refinement, or (in ideal case) to visualize result of refinement? What method was used for determination of size of crystallites? The same for result of Rietveld refinement of $FeO/Fe_3O_4/FeOOH$ discussed e.g. at Page 67, 70.

3. At page 35 author mentioned several characterization methods. Do you plan for future involve some of vibrational spectroscopy methods like Raman spectroscopy to distinguish nanoparticles (especially in amorphous state)? What results might be expected?

4. It is found, that particles size vary with molecular weight of coating agents (e.g. dextran, page 53), and particles are found in agglomerated state. Have you considered to perform Zeta potential measurements in colloids and, eventually, modify to value in order to prevent agglomeration and increase stability?

5. Based on today's knowledge, could you please explain what the expected real limits of the magnetic nanoparticles for hyperthermia are?

Presented doctoral thesis of Mgr. Teraza Sojková fulfil all demands and I recommend the work to be defended.

In Košice, 13.5.2023 RNDr. Martin Fabián, PhD.