Referee report on PhD thesis

"SYNTHESIS OF IRON(II) DOPED COPPER FERRITES AS NOVEL HETEROGENEOUS PHOTO-FENTON CATALYSTS"
by Engr. Asfandyar Khan

Supervisors: Prof. Dr. Ottó Horváth and Dr. Zsolt Valicsek

The submitted doctoral thesis is devoted to the study of the iron doped copper ferrites and their application as novel heterogeneous photo-Fenton catalyst. There is a growing interest to explore various metal oxides in photocatalytic applications (e.g. in waste water treatment). Most of the photocatalytic dye degradation studies have been published using titanium dioxide as a photocatalyst. However, the major disadvantage of TiO_2 is that it absorbs only in the UV region. The topic of this thesis is complex: the synthesis of the new iron doped copper ferrites as novel photocatalyst working in the visible wavelength and their use for the oxidative degradation of organic pollutants. The thesis therefore has a high scientific and practical relevance.

From the formal point of view, the thesis is well structured into chapters and contains all usual items like the lists of references, tables, figures and abbreviations used in the text. The figures, tables, references and the text itself are processed according to standards. The bibliography of the thesis contains 220 references in standard format. SI units are used throughout the text.

The thesis is of a predominantly experimental character and presents impressive amount of preparative work. All used experimental methods are up-to-date: standard methods in respective field of material science (DLS, Spectrophotometry, SEM/EDS, XRD, Diffuse reflectance spectroscopy). The candidate describes these in a clear way, demonstrating his knowledge and the capability to apply these methods in characterization of iron doped copper ferrites.

I have had opportunity to take part in the pre-defence as referee. I had several critical comments to the text including the main thesis points. The candidate has substantially improved the text and made important corrections according to my comments. I acknowledge the corrections made and accept all the results as new and the candidate's own results.

My questions and remarks in the pre-defence concerned mostly the synthesis of spinels and their characterization by various analytical methods. The current questions, however, are related to the significance of the results.

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Questions:

1. Is there a standardized photochemical degradation experiment? What are the proper controls of these experiments? Is there any way to compare the results from different photodegradation experiments? How do you think your photo-Fenton system performs as compared to other heterogeneous systems?

2. Discuss the applicability of your photo-Fenton reaction in industry. How can the presented photo Fenton process be scaled up to industrial application? One aspect to practical use of such a heterogeneous photo-Fenton process is the amount of the catalyst. In my view, the working range of absorbance (in spectrophotometry) set a limit to the concentration of the photocatalyst during the model experiments presented in the thesis. How would you discuss the useful concentration values of catalyst or other important parameters in real applications?

The results of the thesis have been already published in 2 papers in reputable journals with high impact factor (Nanomaterials). Besides these papers, a new manuscript is accepted to the Journal of Industry and Chemistry. In conclusion, the thesis presented by Asfandyar Khan contains valuable and original results. I confirm that this work fully satisfies a level of PhD and I recommend that Asfandyar Khan should be granted the permission to defend the PhD theses. After successful doctoral defense I recommend that the Candidate is awarded the doctoral degree.

22. June, 2021. Budapest

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