Institute of Geotechnics
Slovak Academy of Sciences
Watsonova 45, 040 01 Košice

CRN: 00166553, Phone: +421 55 7922601, Fax: +421 55 7922604, E-mail: ugtsekr@saske.sk, URL: http://ugt.saske.sk

October 18, 2019

To Whom It May Concern

REVIEW
of the foreign scientific supervisor
RNDr. Matej Baláž, PhD. (Institute of Geotechnics, Slovak Academy of Sciences)

for the dissertation thesis of MSc. Zhandos S. Shalabayev

„Solid-phase and liquid-phase preparation of sulfur nanoparticles and their composites: properties study and application fields“
submitted for the degree of Doctor of Philosophy (PhD.) in the speciality
6D072000 - Chemical Technology of Inorganic Substances

Sulfur represents a cheap and interesting precursor for many materials with multidisciplinary application. Its transformation into nano-range brings about even broader scope. It is very often present in nature, but also in synthetic materials in the form of sulfides, which are also very interesting materials, for example for energetic industry.

The thesis under consideration is highlighting the main directions in sulfur-based materials science, thus making it very actual and important for the scientific community. In the literature review, a detailed description of the preparation methods of sulfur nanoparticles and also the mechanism of their biological activity is provided. The same is then done for CuS in the next part. These parts of the thesis have the features of a good review article, which is really appreciated and should be considered for possible publication as a review in future. Afterwards, the composite materials, combining the beneficial properties of each component, are briefly discussed. Also carbonates are good candidates for composites with sulfur, which has been clearly outlined in that part.

The experimental work focused on selected examples of liquid-phase and solid-phase syntheses. Namely in the second case, the environmentally friendly approach has been used, as mechanochemistry uses solvent-free environment and makes the synthesis of nanomaterials possible without the use of toxic organometallic precursors. Usually just a mixture of starting elements and ambient conditions are sufficient for the synthesis. In addition, it is also a scalable approach.

The results and discussion in the thesis are written in a comprehensive and detailed manner, in a way how MSc. Shalabayev worked during his PhD. study. They are mostly composed of the results published in individual publications of the PhD. student.

During his study, he absolved two scientific internships at the Department of Mechanochemistry at the Institute of Geotechnics, Slovak Academy of Sciences in Košice, Slovakia under my guidance. His first stay (July-August 2018) was focused on the mechanochemical synthesis of CuS/S nanocomposites. Because of his hard-working attitude, he was able to produce a material which became a core of his first-author publication in the journal

Institute of Geotechnics
Slovak Academy of Sciences
Watsonova 45, 040 01 Košice

CRN: 00166553, Phone: +421 55 7922601, Fax: +421 55 7922604, E-mail: ugtsekr@saske.sk, URL: http://ugt.saske.sk

ACS Sustainable Chemistry & Engineering with IF almost 7. Namely, he realized milling experiments and Soxhlet analysis. He also assisted when preparing the samples for further characterization methods, namely XRD measurements and was present when a responsible colleague was performing the measurements (e.g. SEM). He was keeping the time plan we made without problems and also his attitude towards additional work which often occurred was positive. At the end, he also held a presentation at our Institute where he presented the obtained results. During the second internship (June 2019), he attended two conferences, where he presented the obtained results and was also working on the revision of the above-mentioned paper. He also served as a great mechanochemical guide for the other two students who were with him in Košice.

The PhD. student completed the research aims of the thesis and discussed also the possibility to apply the proposed methodologies for the production of the synthesized materials at an industrial level, which is very beneficial and is a great justification for the work performed. To sum up, I did not have the pleasure of working with many colleagues, who would be more hard-working than MSc. Shalabayev until now. He is over-performing many Slovak colleagues in this. Despite being oversaturated also with administrative work in Kazakhstan, he could still find time to work on the scientific goals of the thesis.

As a foreign scientific supervisor of MSc. Zhandos S. Shalabayev, taking into account the results obtained in the thesis and the personal qualities of the applicant, I am of the opinion that his dissertation thesis meets the qualification requirements of an international standard for a Ph.D. and I strongly endorse it for the presentation to the Dissertation Council of your University and I am sure that the PhD. student deserves awarding the Ph.D. degree in the specialty 6D072000 - Chemical Technology of Inorganic Substances.

Sincerely yours,
A foreign scientific supervisor

RNDr. Matej Baláž, PhD.

Slovenskej akadémie vied
Ústav geotechniky
KOŠICE

Dr. Slavomír Hredzák
director