

Recommendation from supervisor for defence of Ph.D. thesis
„Preparation and study of simonkolleite and zinc oxide from aqueous precipitation of zinc chloride“

worked out by M.Sc. Simon Cousy

The main goals of this thesis were to test simple and cost-effective methods for synthesis of nanoparticle ZnO and/or simonkolleite (zinc hydroxide chloride) based on a precipitation of salts in aqueous media. The both materials mentioned above are interesting for their prospective utilization such as photocatalysts, catalyst supports, anticorrosive agents and fillers for polymeric matrix. At the most promising method the precipitation mechanism and the influence of different synthesis parameters on the product properties were studied. Further aim was to study the effect of n-butanol on simonkolleite and ZnO stabilization in aqueous suspension. Finally, three potential applications were explored for the synthesized products: ZnO as a photocatalyst, simonkolleite as an anticorrosive agent, and surface modified simonkolleite as a filler for a polymeric matrix. Student worked out his thesis in laboratories of TOSEDA, spol. s r.o. under the professional supervision of Dr. Jiří Zelenka.

Two synthesis methods were tested to produce ZnO, following a wet precipitation of ZnCl₂ salt. In the first method hydrogen peroxide was used as a source of oxygen, but the Zn²⁺ ions were also oxidized into Zn⁴⁺ and yield ZnO₂ rather than ZnO. In the second method only OH⁻ ions were the main source of oxygen. This method allows yielding both ZnO and simonkolleite and therefore the precipitation mechanism of these reactions was studied in detail. It was concluded that a higher molar ratio of OH:Zn favored the formation of ZnO, while the addition of Cl⁻ ions did have a faint influence on the nature of the product. The initial pH had a strong influence on the size of the simonkolleite particles. Butanol was found to improve only slightly the dispersion stability of simonkolleite into water.

The use of simonkolleite as anticorrosive agent after intercalation of phosphates and thermal conversion of simonkolleite into ZnO were tested and photocatalytic activity of synthesized ZnO was proved. Polymeric composites were prepared from simonkolleite particles and their properties were evaluated. It is necessary to remark, that these topics would deserve more attention in this dissertation.

The major outputs of thesis are the understanding of simonkolleite/ZnO formation and the control over the proportion of simonkolleite and ZnO in the final product by controlling the synthesis conditions. It was also shown that simonkolleite has a potential for barrier effect in polymeric composites.

M.Sc. Simon Cousy orientated himself in studied problems very well, proved great experimental skill and ability to work in the creative manner. He published results of his research in 2 articles in impacted journals, in 1 reviewed paper and in 9 contributions at international and national conferences. We recommend his doctoral thesis to defence.

Pardubice, 10.12.2018

doc. Ing. Ladislav Svoboda, CSc., supervisor
Ing. Jiří Zelenka, CSc., supervisor - specialist

