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Preparation of tungsten-oxide, tungstate and molybdenum-oxide nanostructures by hydrothermal method

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Most important 5 publications from the author

1) T. Nagyné-Kovács, Gy. Pokol, F.Gáber, D. Nagy, T. Igricz, I. E. Lukács, Zs. Fogarassy, K. Balázsi, I. M. Szilágyi, Preparation of Iron Tungstate ($FeWO_4$) nanosheets by hydrothermal method, Materials Research Bulletin 95 (2017) 563–569, doi:10.1016/j.materresbull.2017.08.03 (IF 2018: 3,355, independent citations: 9)
2) T. Nagyné-Kovács, A. Malik, A. Szenkovits, I. E. Lukács, I. M. Szilágyi, Gy. Pokol, Effects of different anions upon the WO_3 morphology and structure, Journal of Nanoscience and Nanotechnology 19 (2019) 498-501, doi: 10.1166/jnn.2019.15790 (IF 2018: 1,334, independent citations: -)
3) T. Nagyné-Kovács, G. Shahnazarova, I. E. Lukács, A. Szabó, K. Hernádi, T. Igricz, K. László, I. M. Szilágyi, Gy. Pokol, Ph effect in the hydrothermal preparation of Bi_2WO_6 nanostructures, Materials, 12 (2019) 1728, doi: 10.3390/ma12111728 (IF 2018: 2,972, independent citations: -)
4) T. Nagyné-Kovács, B. Mészáros, M. Molnár, M. Tolner, I. E. Lukács, I. M. Szilágyi, Gy. Pokol, Hydrothermal synthesis of Sr-doped hydroxyapatite and its antibacterial activity Periodica Polytechnica Chemical Engineering, accepted (2019) (IF 2018: 1.382, independent citations: -)
5) T. Nagyné-Kovács, L. Studnicka, A. Kincses, G. Spengler, M. Molnár, M. Tolner, I. E. Lukács, I. M. Szilágyi, Gy. Pokol, Synthesis and characterization of Sr and Mg-doped hydroxyapatite by a simple precipitation method, Ceramics International, 4 (2018) 22976-22982, doi: 10.1016/j.ceramint.2018.09.096 (IF 2018: 3.450, independent citations: -)

The tailored production of nanoscale materials and the flexible design of their properties for various applications are among the most important research areas of today. During my PhD work I studied the hydrothermal preparation of tungsten-oxides (WO_3), tungstates ($FeWO_4$ and Bi_2WO_6) and molybdenum-oxides (MoO_3). I examined the effect of the applied reaction parameters focusing on the changes in the crystalline phases and morphology of the products, which play a crucial role in the further usability of the compounds (e.g. in (photo)catalysis, gas sensing).

For the preparation of WO_3, I first investigated the effect of $FeSO_4$ and $NH_4Fe(SO_4)_2$, furthermore $NaClO_4$, Na_3PO_4, and Na_2SO_4 combined with $NaClO_4$ in the hydrothermal reaction of Na_2WO_4 and HCl at 180 and 200 °C. $FeSO_4$ resulted a mixture at 180 °C (hexagonal (h-)WO_3, Fe_2O_3, $FeWO_4$), while at 200 °C the product was pure $FeWO_4$, uniquely with nanosheet morphology. In the case of $NH_4Fe(SO_4)_2$, a mixture phase product formed. With $NaClO_4$ additive orthorhobic-$WO_3 \cdot 0.33H_2O$ with a morphology of rectangular forms was obtained, while Na_3PO_4 gave no solid phase product due to the formation of water-soluble phosphotungatates. When Na_2SO_4 and $NaClO_4$ were combined, h-WO_3 nanorods formed indicating the determining role of Na_2SO_4 in crystal growth. After that, I was the first one to prepare monoclinic (m-)WO_3 by one-step hydrothermal method without additives and clarified the role of strongly acidic pH (0.1) in the hydrothermal reaction of Na_2WO_4 and HCl.

In the preparation of Bi_2WO_6 the role of the pH value of the precursor-solution in the entire pH range was investigated, including the strongly acidic (pH <1) and strongly alkaline (pH> 13) values. It was found that in the strongly acidic range plate-like Bi_2WO_6 formed, which transformed in the alkaline range into $Bi_{3.84}W_{0.16}O_{6.24}$ phase with cube- and octahedral-like morphology.

Studying the effects of the $CrCl_3$ additive used in the hydrothermal preparation of MoO_3, it was found that it resulted unique, metastable, m-MoO_3 phase with nanosheet morphology. Monoclinic MoO_3 was synthetized by a one-step hydrothermal method for the first time.