

DESCRIPTION FOR THE GENERAL PUBLIC (IN ENGLISH)

The research objective is to understand the mechanism of the phenomenon observed by the project author and consisting in the dependence of the size of ZnO nanoparticles (NPs) obtained during microwave solvothermal synthesis (MSS) on water concentration in the organic solvent used. Solvothermal synthesis is a synthesis in the liquid phase at an increased pressure, i.e. at a temperature above the solvent boiling point in normal conditions. The researched process consisted in heating a solution of zinc acetate in ethylene glycol in a pressure chamber. It was observed that during the synthesis of ZnO NPs the size of ZnO NPs was a function of water concentration in the solvent used. An additional project objective is to examine the mechanism of the described solvothermal reaction.

The project work will be carried out by obtaining products of solvothermal synthesis of ZnO NPs with controlled water content in the precursor for varied synthesis times in the MSS2 microwave reactor. The unique MSS2 reactor permits interrupting the ZnO NP synthesis reaction at any time by rapid cooldown and freezing of the reaction, with highest purity preserved. The subsequent work stage will focus on identification of reaction intermediates, examination of water content in the post-reaction mixture and water tracing (D_2O) in ZnO synthesis products. Impact of water content on synthesis efficiency, structure and growth rate of ZnO NPs will be determined. Reaction formulas will be presented taking into account water impact on individual stages of solvothermal synthesis of ZnO NPs. The presented model of ZnO NP size control mechanism will be verified experimentally.

The failure to take into account water presence in solvothermal synthesis may be one of the primary reasons why NPs characterised by unrepeatability of size and properties are obtained. Understanding the mechanism of ZnO NP size control will allow us to further develop and optimise the microwave solvothermal synthesis. The gained knowledge and experience will enable also further development of new designs of microwave reactors.

If the reaction mechanism is known, the reaction can be consciously controlled by changing the environment's parameters, thanks to which the product can be easily and deliberately modified. Controlling ZnO particle size in nanoscale permits modifying their chemical, catalytic, biological, mechanical, morphologic, electrical, optical and structural properties. The project significance is even greater given the fact that the project results might explain unrepeatability of size and morphology of NPs produced at present using solvothermal syntheses.