Preparation of Perovskite Structure and Metal-Oxide Nanomaterials Via Mechanochemical Process

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A common feature of perovskites is the structure represented by the general formula $^{XII}A^{2+VI}B^{4+}X^{2-}_3$. Their versatility is due to the fact that many elements can be doped into the perovskite structure, so that their properties can be changed. A primary consideration in their production is the controllability of crystallization, as some of their properties can be fine-tuned in this way. Their application is not only limited to cheaper solar cells, but can also be used as a sensor and even a catalyst.

We pointed to the synthesis of metal-oxide and perovskite nanoparticles by the mechanochemical reaction in a planetary ball mill (Fritsch Pulverisette 6 planetary ball mill) is suited for fast and high-yield production. Besides the metal-salt precursor Na_2CO_3 and NaCl matrix was applied also. The latter bulks large in the separation of the nanoparticles and in the energy transmission. We state by numerous measurement method (XRD, FT-IR, Raman, TEM, SEM) that the products have uniform morphology and monodisperse size distribution (10 ±5 nm) and after preparation extractable by simple washing. We successfully applied this method to synthesise SnO_2, ZnO, TiO_2 metal-oxide and $ZnTiO_3$ or $NaNbO_3$ perovskite structured nanoparticles.

In the course of our work, our goal was to follow the mechanochemical processes in time with a pressure and temperature measuring head (GTM), which can be mounted specifically on the grinding drum. Thus, the knowledge of the reaction kinetics was expected to be expanded, and a significant shortening of the optimization process was expected with the help of the measuring unit. We performed the production of different nanoscale perovskite structures in a planetary ball mill. Each of the produced materials was characterized in detail, their properties and the reproducibility of the mechanochemical process were investigated.

Keywords: perovskite, $ZnTiO_3$, $NaNbO_3$.

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