

Gas phase synthesis of zinc oxide materials

Dilger, S., Konstanz

Prof. Dr. Polarz, S., University of Konstanz, Universitätsstraße 10, 78464 Konstanz

ZnO is a very versatile semi conducting inorganic material. Nanometer sized zinc oxide is an interesting material which is widely used in electronics, optoelectronics, catalysis, or drug industry^[1]. The purity, crystallinity and morphology of the ZnO materials represent critical parameters for many of the latter applications^[2], however, they are difficult to control. Here, we present the synthesis of tailor-made ZnO materials using a gas-phase method. A volatile precursor is evaporated and can be reacted to various zinc oxide materials under controlled conditions.

We present a novel approach for the synthesis of polycrystalline zinc oxide spheres tunable in size from 50-1000nm with crystallite sizes adjustable from 5-40nm, which influences surface roughness and surface area, while retaining crystallite connection within the spheres. The formation of the spherical particles is a consequence of the rather unusual mechanism involving a precursor-determined polymerization step. The spheres

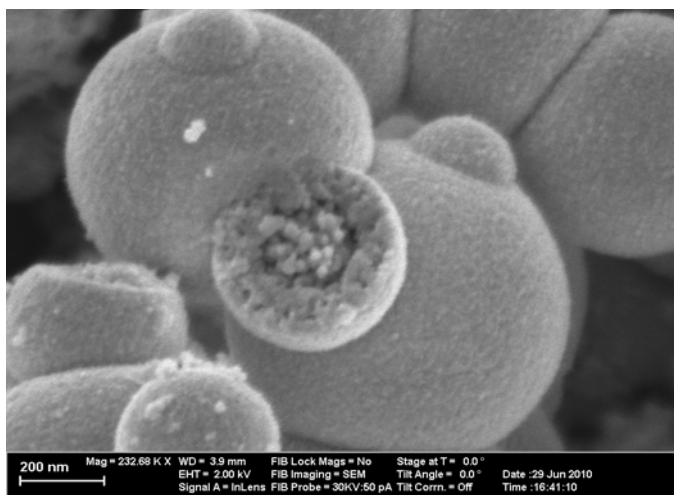


Fig. 1: ZnO spheres prepared in the gas-phase.

that are formed initially are amorphous in nature as shown by PXRD measurements. However, further heat treatment induces crystallization of ZnO in the Wurtzite phase. It can be shown that the ZnO spheres possess an interesting nanostructure.

Under alternative conditions, when the precursor-determined growth is excluded, one obtains small ZnO nanocrystals directly. These nanocrystals can agglomerate into highly porous structures, regarding structure similar to aerogels. However, in comparison to aerogels prepared via sol-gel processes the materials prepared in the gas-phase exhibit higher purity and better crystallinity.

The materials were further characterized by impedance measurements and potential applications as sensor materials were tested.

[1] S. J. Pearton, et al.; *J. Vac. Sci. Technol.* **2004**, 22, 932. [2] S. Polarz, et al.; *Adv. Funct. Mater.* **2007**, 17, 1385-1391.