

The Influence of Thermal Treatment on the Phase Development of ZrO₂-ZnO Precursors

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The amorphous precursors of the ZrO₂-ZnO system at the ZrO₂-rich side of the concentration range were prepared by co-precipitation from aqueous solutions of the corresponding salts. Structural and microstructural changes during the thermal treatment of the amorphous precursors were examined by differential scanning calorimetry, X-ray powder diffraction, Raman spectroscopy, Fourier transform infrared spectroscopy, field emission scanning electron microscopy and energy dispersive X-ray spectrometry. The crystallization temperature of the amorphous precursors increased with an increase in ZnO content, from 453 °C (0 mol% ZnO) to 551 °C (~25 mol% ZnO). The phase analysis results showed that maximum solubility of Zn²⁺ ions in the ZrO₂ lattice (~25 mol%) occurred in the metastable products obtained after crystallization of the amorphous precursors. The incorporation of Zn²⁺ ions partially stabilized the tetragonal ZrO₂ polymorph. A precise determination of unit-cell parameters using the whole-powder-pattern refinements shows that the unit-cell parameters of the tetragonal ZrO₂ solid solution decrease with an increase in Zn²⁺ content. The increase in zinc content above its solid-solubility limit leads to the appearance of a phase structurally closely related to zincite. Further temperature treatment (up to 1000 °C) leads to an increase in the zincite-type phase followed by the transition of metastable tetragonal ZrO₂ into a thermodynamically stable monoclinic ZrO₂ polymorph.