Physico-Chemical nanomaterials science

Variation of physicochemical properties of nanocrystalline powder (mol.%) 88 ZrO_2 – 12 CeO_2

I.O. Marek, O.K. Ryban, V.P. Red'ko, M.I. Danylenko, O.V. Dudnik

Frantsevich Institute for Problems of Materials Science NAS of Ukraine
Krzizanivsky str., 3, Kyiv-142, 03680, Ukraine.
Mega_marekirina@ukr.net

Ceramics based on zirconia, stabilized with ceria, is characterized by high fracture toughness (to 20 $mPa*m^{-0,5}$) and increased resistance to aging (low-temperature uncontrolled phase transformation T-ZrO_2 → M-ZrO_2 in the humid environment). Moreover, ceramics in the ZrO_2 - CeO_2 system is characterized by "shape memory". Great perspectives of using composites of this system in medicine are opened due to this features. The properties of composites depend greatly on the properties of starting powders. The properties of initial nanocrystalline powders are determined by their preparation method.

The aim of the work is investigation the properties of hydrothermal nanocrystalline powder (mol.%) 88 ZrO_2 – 12 CeO_2 after preparation and heat treatment in the temperature range 400 - 1300°C.

Initial nanocrystalline powder was obtained by hydrothermal synthesis in an alkaline medium.

X-ray diffraction, differential thermal analysis, BET method and electron microscopy were used for investigation of the powder properties.

It was determined that after hydrothermal synthesis the bland of the low-temperature metastable cubic solid solution based on zirconia (F-ZrO_2) and tetragonal solid solution based on zirconia (T-ZrO_2) were formed. The average size of primary particles reached 1-2 nm. Aggregates were achieved the size of 20 nm, which in turn, were assembled in agglomerates up to 5 μm. Specific surface area of the powder was 107 m^2 / g.

The phase transformation of F-ZrO_2 → T-ZrO_2 during heat treatment is completed at 1000°C. Specific surface area of nanocrystalline powder varied from 91m^2/g to 0, 27 m^2/g. The average size of primary particles increased to 20 nm. The sintering of powder was started at 1000°C.

The preducing powder will be used in the microstructural designing of ZrO_2 - based composites.