which improves the quality of the treated surface layer and reduces surface roughness.

An important issue of research remains the optimization of cutting parameters when turning various metals and alloys, the search for the most effective area of the developed tool materials. Given the wide range of hard-to-cut, high-hard alloys, in order to determine the optimal field of application of blade tool material, it is advisable to test tool cutting inserts using an accelerated method. To do this, there are a number of techniques for blade tools.

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ДОСЛІДЖЕННЯ ФОРМУВАННЯ І СПІКАННЯ СИНТЕЗОВАНИХ ПОРОШКІВ ZRO_2 З ФТОРИДНИХ РОЗЧИНІВ

STUDY OF FORMATION AND SINTERING OF SYNTHESIZED ZRO_2 POWDERS FROM FLUORIDE SOLUTIONS

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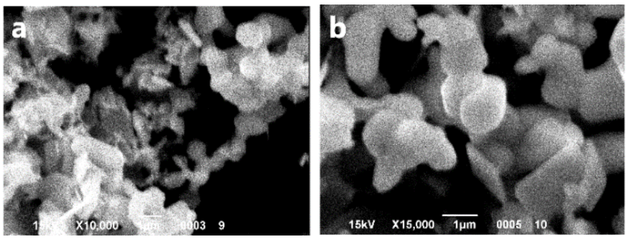
Zirconia is characterized by high melting point, low thermal conductivity, high chemical resistance and mechanical strength, heat resistance, high ionic conductivity and biocompatibility. These properties determine the various applications of materials based on zirconium dioxide in fuel cells, catalysts, thermal barrier coatings, and medical implants etc.

The aim of the work is to study the influence of precursor precipitation conditions from fluoride solution on the formation of micro- and nanoparticles of zirconium dioxide and the choice of optimal conditions for obtaining particles for their further use in the production of ceramics.

ZrO2 nanopowders were synthesized by precipitation from fluoride solutions followed by thermal annealing. The samples were formed by hot pressing in a vacuum chamber using an electric sintering unit, which allows to obtain consolidated ceramic materials, without impurities and with minimal grain growth within a few minutes [2]. The study of the surface morphology of the obtained powders was carried out using a scanning microscope (SEM) JSM-6390LV. Infrared (IR) spectra were obtained on a FTIR spectrophotometer SPECTRUM ONE (Perkin Elmer) in potassium bromide tablets. X-ray diffraction measurements were carried out on a diffractometer with a graphite monochromator on the primary beam (CuKα radiation). Phase identification was carried out using Profex. The density of the sintered sample was determined by the Archimedes method and then converted to relative density Dr as follows

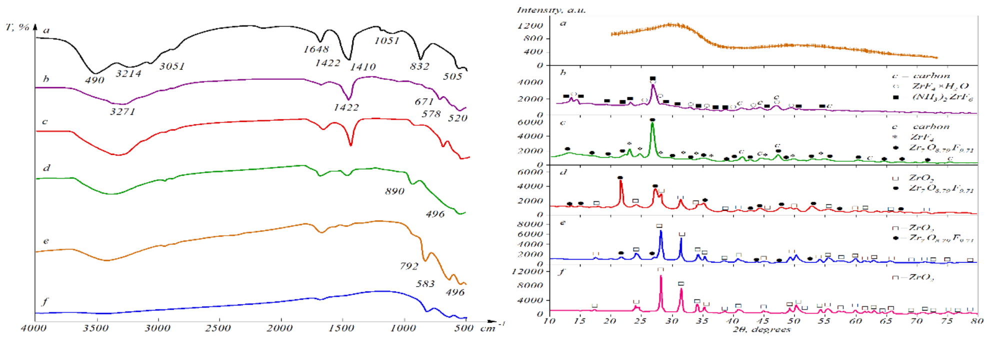
$$\frac{Dr}{Dm} = Dt \cdot 100\% \qquad (1)$$

where D_m– measured density, g/sm^3; D_t – theoretical density, g/sm^3.



a *b*

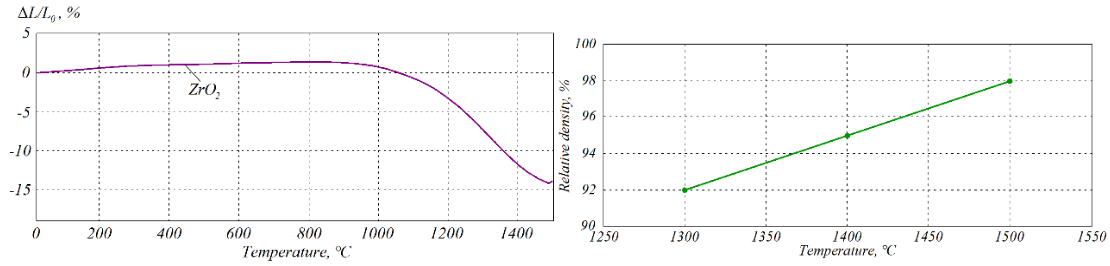
Fig. 1. Microphotographs of ZrO2 particles obtained after annealing at 800 °C with polyvinyl alcohol admixture at the ratio m(Zr):m(PVC): a - 1:0.1; b - 1:1



a *b*

Fig. 2. Infrared spectra (a) and diffractograms (*b*) of the sample of ZrO_2 precursor, which was obtained by precipitation (20 °C) with an admixture of polyvinyl alcohol (a), in the process of thermal heating for 1 hour, °C:*b* – 200, *c* – 300, *d* – 400, *e* – 500, *f* – 600

Fig. 2 represents the results of the particle sintering. It was found that the sintering of particles begins at a temperature of about 1000 °C. The sintering process takes place in the temperature range of 1000...1500 °C.



a *b*

Fig. 3. Dependence of shrinkage during sintering of ZrO_2 particles (a) and relative density of hot-pressed samples of ZrO2 composition on sintering temperature (*b*)

To conclude, the preparation of ZrO_2 nanopowders from fluoride solutions by precipitation followed by thermal annealing has been investigated in this work. It was found that the formation of particles is influenced by such factors as synthesis temperature and concentration of components. The most finely dispersed and monodisperse particles are formed from dilute solutions with a zirconium concentration of 0.02...0.04 mol/L and a mass ratio of mZr:mPVC 1:0.1. Testing of the method of electroconsolidation for the production of zirconia ceramics showed the possibility of its practical use.

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