

NANOMATERIALS FOR SOFC ELECTROLYTES AND ANODES ON THE BASE OF ZIRCONIA

T.E. Konstantinova, I.A. Danilenko, N.P. Pilipenko, G.K. Volkova

A.A. Galkin Donetsk Institute for Physics and Engineering

72 R. Luxemburg Str., Donetsk 83114 Ukraine

The main problems of SOFC development are the increase of ion conductivity of the electrolyte, the reduction of the working temperature, longer lifetime, the number of thermal cycles and the enhancement of chemical firmness of a fuel cell .

The solution of these problems becomes possible due to the use of nanostructure materials.

The present paper depicts experimental results concerning the improvement of the method of co-precipitation by the use of physical effect of ultra sound (US), impulse magnetic field (IMF), and MW heating. The main aim of the work is obtaining of nano-dispersed, weakly aggregated powders of tetragonal $ZrO_2 + 3 \text{ mol. \% } Y_2O_3$ from cubic $ZrO_2 + 8 \text{ mol. \% } Y_2O_3$ with the use of cheap ukrainian raw materials.

While obtaining stabilized zirconia, the processes of dehydration and dehydroxilization (the release of OH groups) were studied by means of electron microscopy, X-ray structure analysis and NMR.

The results of the investigation show that MW drying of zirconia dioxide as well as applying of IMF field causes the increase of the rate of dehydration. It is equal to 0.2 %/min in the case of convection drying and 1.6 %/min for MW drying at the equal quantity of the material to be dried (Fig.1). The use of ultrasonic treatment combined with IMF and MW effect results in the raise of the specific surface.

The method of NMR study allowed to separate at least two lines (wide and narrow) from NMR proton spectrum of samples after heating at 500°C (see Fig.2). As far as preliminary heating at 120°C removes physically bound water, the presence of two lines can be conditioned just by protons of hydroxile groups OH in two different states.

The obtained results allow us to make a conclusion, that at properly chosen conditions of the treatment, it is possible to synthesize a weakly agglomerated powder of zirconia dioxide (3 mol % and 8 mol % Y_2O_3) characterized by tetragonal modification and narrow distribution of particle size. The powder with CSA size equal to 8-10 nm and the specific surface more than 100 m^2/g is presented on Fig. 3.

The possibility of obtaining of ceramic composite samples based on ZrO_2 with addition of Ni is also presented in the paper.

SEM study of fractures has shown small grain size and high dispersibility and homogeneity of the distribution of highly dispersed Ni particles in the composite.

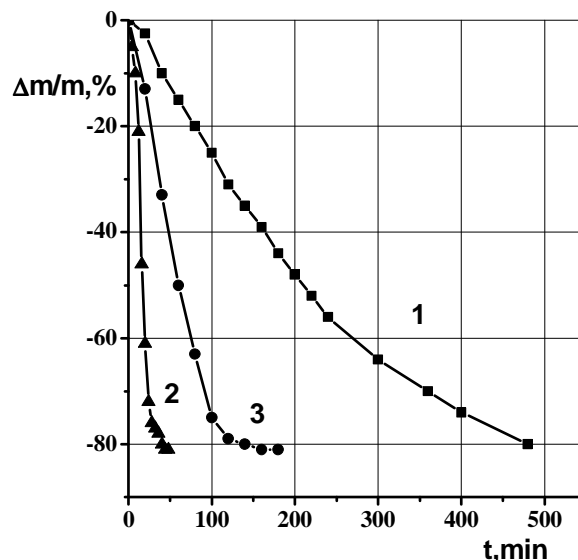


Fig.1. The kinetics of drying of zirconia dioxide : 1) at 120°C; 2) in MW field; 3) in IMF field at 120°C.

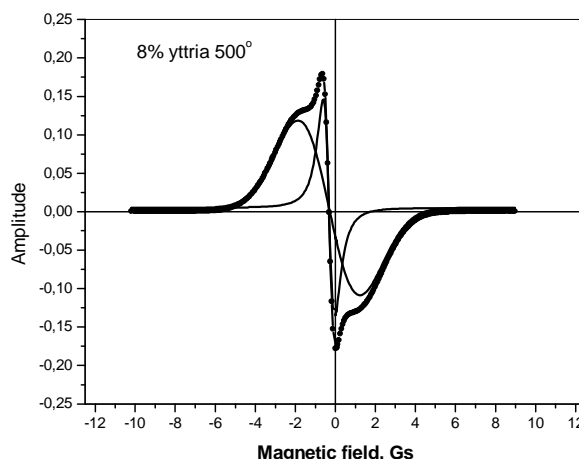


Figure 2. NMR 1H spectrum of $ZrO_2-8 \text{ mol \% } Y_2O_3$ powders calcinated at 500°C : 1) experimental curve; 2) Gauss fitting curve of the derivative of absorption line.

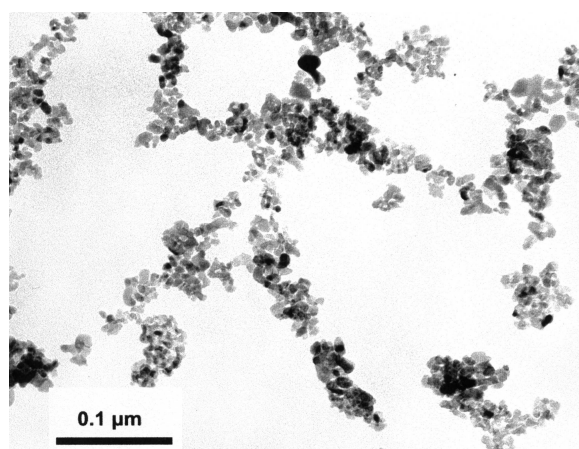


Figure 3. TEM image of crystallized powder $ZrO_2 - 8\% Y_2O_3$.