The Production Mechanism of Al_2O_3-ZrO_2 Nanopowder Via Metal-Containing Polymer Precursors

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Thermal transformations of metal-containing monomer (MCM) are of interest at least for two reasons: first, the study of thermal decay of MCM and its transformation products makes it possible to evaluate MCM thermal stability and its role in solid state polymerization processes. Second, an investigation of MCM thermal decay is of interest in connection with the preparation of highly dispersed nano-sized metal oxide (or metal) particles stabilized in the polymer matrix. In distinction to the other known approaches, this method could successfully combine the processes of synthesis and chemical passivation of nano-sized particles. Besides, it is an important step towards solving the problem of preparing perfect composite nanopowders.

The main objective of this work was investigation the production mechanism of Al_2O_3-ZrO_2 nanopowder through the polyacrylamide gel-net method. The monomers acrylamide, *N*,*N'*-methylene-bis-acrylamide, persulphates and *N*,*N*,*N'*,*N'*-tetra methyl ethyl diamine were used to obtain gel at 4 ºC. These polymer networks trapped and coordinated particles so that inhibited aggregation of Al_2O_3-ZrO_2, improved homogeneity, decreased agglomeration and produced narrow particle size distribution.

The Al_2O_3-ZrO_2 nanopowders were obtained by heat treatment of precursor up to 1300 ºC. Complex between monomer and ions were identified by UV-VIS and FTIR spectroscopy (Figs. 1,2,3 and 4). Particle morphology and phase transformation during heat treatment were studied by scanning electron microscopy (SEM) and X-ray diffractometry (XRD), respectively (Figs. 5 and 6). The nanopowders showed a spherical shape with particle size between 40 and 70 nm.

References:

[1] Pittman, Charles U. Carraher, Charles E. Zeldin, M. Sheats, John E. Culbertson, Bill M. Metal-containing polymer materials. Plenum Press. New York and London 1996.

[2] Sarkar, D. Adak, S. Mitra, N. K., Composites**, Part A 38**, 2007, 124.

[3] Sarkar, D. Mohapatra, D. Ray, S. Bhattacharyya, S. Adak, S. Mitra, N. Ceram. Int., **33**, 2007, 1275.

Figures:

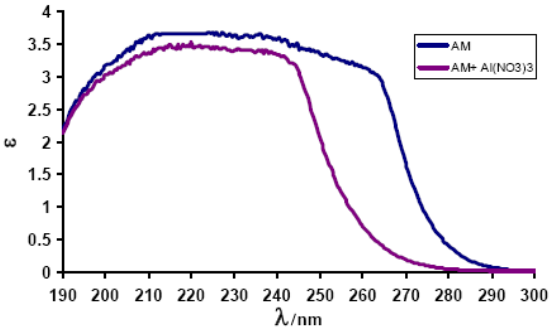

Fig 1. The UV-vis spectra of the aqueous solution of AM and AM/$Al(NO_3)_3$

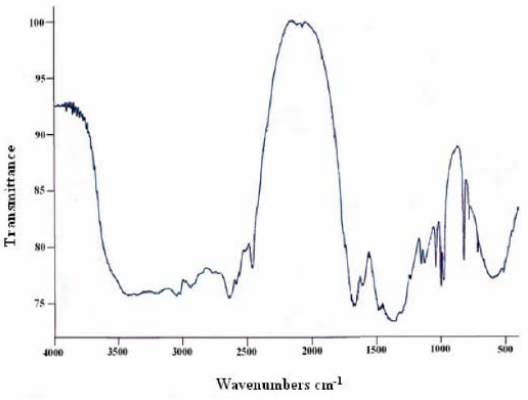

Fig. 4, Infrared spectrum of coordinated ions with polyacrylamide gel.

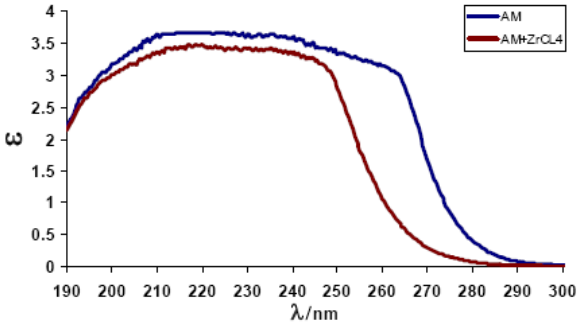

Fig 2. The UV-vis spectra of the aqueous solution of AM and AM/$ZrCl_4$

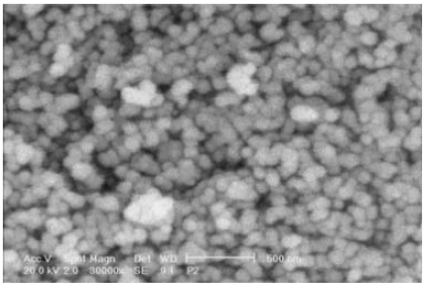

Fig. 5, SEM image of the Al_2O_3-ZrO_2 nanopowder.

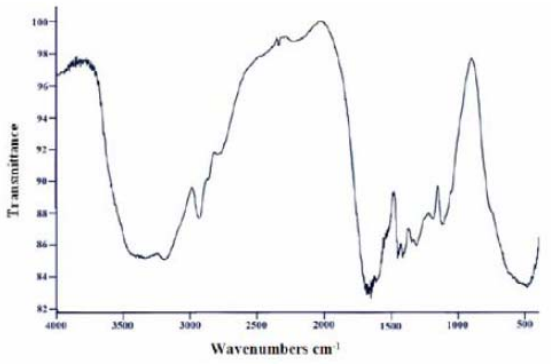

Fig. 3, Infrared spectrum of polyacrylamide gel.

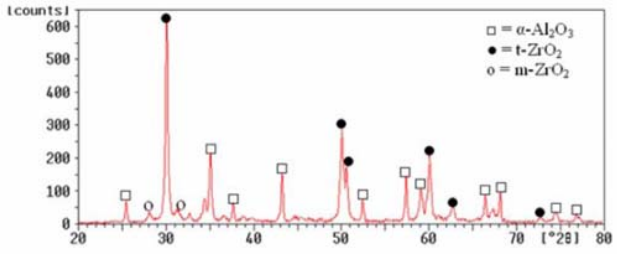

Fig. 6, XRD pattern of Al_2O_3-ZrO_2 nanopowder heat treated at 1300 °C for 1h.