

## New materials in the $\text{Al}_2\text{O}_3\text{--Zr(Hf)O}_2\text{--Ln}_2\text{O}_3$ systems

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Ternary systems  $\text{Al}_2\text{O}_3\text{--Zr(Hf)O}_2\text{--Ln}_2\text{O}_3$ , where Ln - lanthanides and yttrium, are the scientific basis for a variety of structural and functional materials. The properties of zirconates  $\text{Ln}_2\text{Zr(Hf)}_2\text{O}_7$  with pyrochlore-type structure (high melting points up to 2300 °C, no phase transformations in all areas of existence, high heat resistance, low thermal conductivity, moderate coefficient of thermal expansion) meets the materials requirements for one or multi-layer thermal barrier coatings (TZP) for hot zone of gas turbine engines.

In modern thermal barrier coatings (TBC) thermal isolation of metal components is realized through upper coating made of partially yttria stabilized zirconia (YSZ) or other materials. Oxidation chemical protection is provided by thin  $\alpha\text{-Al}_2\text{O}_3$  layer (thermally grown oxide, TGO), formed between bonding coating (BC) and thermal barrier coating during article operation. Therefore investigation of phase relations between pyrochlore-type compounds and  $\alpha\text{-Al}_2\text{O}_3$  is very important in the TBC development.

Based on the experimental data obtained during elements construction of a number of phase diagrams  $\text{Al}_2\text{O}_3\text{--HfO}_2\text{--Ln}_2\text{O}_3$  the existence of three-phase eutectics in  $\text{Al}_2\text{O}_3$ -rich areas were found. It was established that the number of eutectics were crystallized in obedience to the mechanism of co-operative phase growth. The highest melting temperature in the system is 2820 °C and it corresponds to  $\text{HfO}_2$  melting point. The minimum melting temperatures in the systems are 1600–1760 °C and they correspond to the melting temperatures of three-phase eutectics. Materials in the systems studied are perspective for development of high temperature structure composite materials on the basis of directed crystallization of two-phase and three-phase eutectics, materials for thermal barrier coatings (TBC), materials for solid electrolytes (SOFCs), oxygen sensors, refractories, etc.