ELECTROCERAMICS IX

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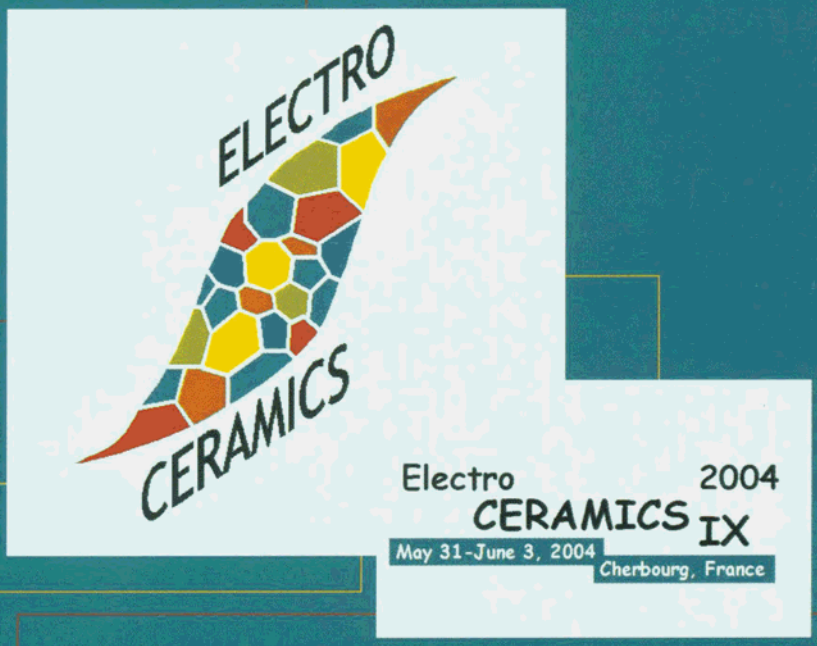

Programme & Abstracts

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Electro CERAMICS IX 2004

Effect of combined doping (Y2O3+ Fe2O3) on structural peculiarities of nanodispersed ZrO2

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Abstract

The most effective stabilizer for zirconium oxide is yttrium oxide. However, the structure of Y-ZrO2 degraded at low temperature. Partial substitution of Fe3+ for Y3+ in system Y2O3-ZrO2 decreases both the crystallization and sintering temperature of zirconia ceramic. It is known that the content of monoclinic (M), tetragonal (T) and cubic (C) polymorphs determines the properties of ZrO2.

The aim of present work is the investigation of structural peculiarities (polymorphs, positions of atoms, site occupancies, local environment of Fe3+) of zirconium oxide stabilized by combined dopant (Y2O3 and Fe2O3) depending on chemical composition ((1-x)ZrO2.xY2O3.yFe2O3, where x+ y=0.03-0.08), synthesis conditions (coprecipitation of hydroxides or successive precipitation of hydroxides) and heat treatment (970-1570 K).

It has been shown that solubility of iron in Y-ZrO2 increases with yttrium content. Iron dissolves completely in Y-ZrO2 at Y/Fe;2. Increasing Y/Fe ratio in ZrO2 doped with the same total amount of doping oxides stabilizes the structure and inhibits low-temperature degradation. Increasing the total amount of doping oxides extends the temperature range of existence of C and C+ T polymorphs of ZrO2. Mssbauer spectra of fully stabilized tetragonal Y-Fe-ZrO2 showed that distribution of Fe3+ ions has a cluster topology. Two nonequivalent sites of Fe3+ with octahedral coordination in coprecipitated samples and three nonequivalent sites of Fe3+ with octa-, penta- and tetrahedral coordination in successively precipitated samples have been identified. Decrease in coordination number of iron ions in comparison with that of host cations in Y-ZrO2 stabilizes the structure and inhibits its degradation due to increase in Me-O binding energy. It has been shown that precipitated ZrO2 powders contain nanoparticles with grain size of 10-20 nm. Successiv