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SPATIAL DISTRIBUTION OF CRYSTALLINE PHASES IN SM-DOPED ZRO_2

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It is widely known that doping with lanthanides is widely used for stabilizing ZrO_2 (zirconia) in tetragonal and cubic phases and improving it's ionic conductivity[1]. Doped zirconia has many applications like light emitting devices, laser cavities and gas sensors[2]. Different type and shape of zirconia samples can be prepared by using increasing number of preparation methods ranging from high quality crystalline solid state reactions to various amorphous sol-gel methods. The diversity of the methods means that the morphology and phase structure of such zirconia is often unknown or characterized only by averaged characterisation method like x-ray scattering which does not reveal the microscopic structure of the material.
The aim of current paper is provide a simple optical characterization method for mapping the spatial phase distribution of zirconia on microscopic scale by using micro-Raman scattering of zirconia and photoluminescence of stabilizing dopant ion.
The bulk zirconia samples doped with different concentrations of samarium are prepared by directional solidification of melt technique (a skull melting technique) at temperatures reaching 3000^{o}C. Characterization of the phase structure of the samples was performed on a Renishaw micro-Raman microscope in Raman scattering and in photoluminescence gathering mode.
By lateral confocal scanning of the samples a microscopic segregation of tetragonal and monoclinig phases of zirconia is revealed both via Raman scattering of the zirconia and photoluminescence spectra of the samarium ions[3,4]. The phase stabilization is shown to be related to samarium ion concentration leading to the formation of tetragonal phase at higher dopant levels compared to the monoclinic.

References

[1] B. Liang, C. Ding, H. Liao, C. Coddet, Journal of the European Ceramic Society, 2009, Article in Press
[2] J. D. Fidelus, W. Lojkowski, D. Millers, L. Grigorjeva, K. Smits and R. R. Piticescu, Solid State Phenomena, Vol. 128, (2007), 141-150
[3] S. Lange, I. Sildos, M. Hartmanova, J. Aarik, V. Kiisk, Journal of Non-Crystalline Solids, 2008 , 354, 4380–4382
[4] E. De la Rosa-Cruz, L.A. Diaz-Torres, P. Salas, R.A. Rodriguez, and C. Angeles, 2004, Proc. Of SPIE Vol. 5510, 57-67