Photoacoustic Thermal Characterization of Porous Rare-Earth Phoshate Ceramics

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Rare earth phosphate ceramics are well known for their thermal phase stability, high melting points (above 1900 ºC), excellent resistance to corrosion and irradiation, and mechanical properties, and these materials constitute precursors for the further development of thin films and coatings for porous ceramic substrates and composites [1-2]. However, the performance of the devices based on these materials is essentially determined by their thermal properties. In this work, the laser induced non-destructive photoacoustic technique has been employed to measure the thermal diffusivity of lanthanum phosphate ceramics prepared by the sol-gel route. The thermal diffusivity value is evaluated by knowing the transition frequency between the thermally thin and the thermally thick region from the amplitude spectrum of the photoacoustic signal. Analysis of the data is carried out on the basis of the one-dimensional model of Rosencwaig and Gersho [3]. The present investigation reveals that the sintering temperature has a great influence on the porosity of the specimen and therefore the propagation of heat carriers, and consequently on the thermal diffusivity value. By considering porous ceramics as a two-phase network in which pores are randomly embedded in a solid-matrix, the measured thermal diffusivity values are correlated with a modified Leob equation. The variation in thermal diffusivity value with sintering temperature is explained on the basis of variation in pore density, as well as with change in grain size.

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