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A. Garbout, M. Férid



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# Pyrochlore structure and spectroscopic studies of titanate ceramics. A comparative investigation on $\text{SmDyTi}_2\text{O}_7$ and $\text{YDyTi}_2\text{O}_7$ solid solutions

A. Garbout\*, M. Férid

*Laboratoire de Physico-Chimie des Matériaux Minéraux et leurs Applications, CNRSM, technopole de Borj Cedria, B.P. 95 Hammam-Lif, 2050, Tunisie.*

## Abstract

Considering the features in changing the structure and properties of rare earth titanates pyrochlores, the substituted  $\text{Dy}_2\text{Ti}_2\text{O}_7$  may be very attractive for various applications. Effect of Sm and Y substitution on the structural properties of  $\text{Dy}_2\text{Ti}_2\text{O}_7$  ceramic was established. These ceramics were prepared by solid-state reaction and characterized by X-ray diffraction and Raman spectroscopy. Both analysis show that  $\text{YDyTi}_2\text{O}_7$  with the pyrochlore structure is obtained after heating at  $1400^\circ\text{C}$ , but  $\text{SmDyTi}_2\text{O}_7$  has already formed after sintering at  $1200^\circ\text{C}$ . SEM images revealed that the average grain size was increased with the increase of heating temperature, and an un-homogeneous grain growth was detected. The average size was about 37 nm and 135 nm for the  $\text{SmDyTi}_2\text{O}_7$  and  $\text{YDyTi}_2\text{O}_7$  particles, respectively. Structural Rietveld refinements indicate that all prepared ceramics crystallize in cubic structure with space group of  $\text{Fd}\bar{3}\text{m}$ . The refined cell parameters demonstrate an almost linear correlation with the ionic radius of  $\text{Ln}^{3+}$ . The vibrational spectra revealed that the positions of bands are sensitive to the  $\text{Ln}^{3+}$ -ionic radius, and the Ti-O bond strength decreased linearly with the increase of cubic lattice parameter. Raman spectra indicate that the wavenumber of O-Ti-O bending mode is considerably shifted to lower region with increasing in mass of the Ln atom. This paper provides solid foundations for additional research of these solid solutions, which are very attractive for different fields as promising catalytic compounds for combustion applications or as frustrated magnetic pyrochlore ceramics.

**Keywords:** Solid state reaction; X-ray diffraction; Spectroscopy; Magnetic properties; Pyrochlore titanates

\*: corresponding author: Ahlem Garbout, Laboratoire de Physico-Chimie des Matériaux Minéraux et leurs Applications, CNRSM, technopole de Borj Cedria, B.P. 95 Hammam-Lif, 2050, Tunisie.

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