11th International Conference
on Advanced Materials

ICAM 2009

Rio de Janeiro Brazil
September 20 - 25

Synthesis and Characterization of the TiO_2-doped $(CeO_2)_{0,8}(GdO_{1,5})_{0,2}$

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Abstract – $[(CeO_2)_{0.8}(GdO_{1.5})_{0.2}]_{1-y}(TiO_2)_y$, where $0 \leq y \leq 0.1$, was synthesized by Polymeric Precursor Method. The thermal analysis showed that the majority of organic compounds derived from the synthesis is eliminated up to 700ºC. The XRD results showed that the samples crystallized as Fm3m cerianite single phase if they are calcined at 700ºC. When calcined at 1000ºC they are monophasic if $y \leq 0.05$ being the secondary phase, $Gd_2Ti_2O_7$ (s.g. Fd3m), was observed in the sample with $y \geq 0.1$. The analysis by EDX confirmed the nominal composition. The BET analysis showed that the samples treated at 700ºC are mesoporous, but significant surface and porosity loss took place at 1000ºC. The MEV image confirmed such a result.

Among several types, the Solid Oxide Fuel Cell (SOFC) shows the higher efficiency for the energy conversion. The doped CeO_2 have attracted much attention as an alternative material for anodic support due to its high ionic and electronic conduction [1]. Titanium oxide (TiO_2) is added to improve this property as well as it is used as a catalyst support for the several oxidation reactions [1,2]. This work aims to investigate TiO_2 effect on the structure of cerium/gadolinium oxide, $[(CeO_2)_{0.8}(GdO_{1.5})_{0.2}]_{1-y}(TiO_2)_y$, where $0 \leq y \leq 0.1$. The materials were synthesized by Polymeric Precursor Method and calcined at 700ºC, 1000ºC and 1150ºC for 4h in air. The characterization was carried out by simultaneous thermal analysis (TG/DTA), X-ray Diffraction (XRD) (refining by Rietveld Method), Scanning Electronic Microscopic (MEV), Energy Dispersive X-ray (EDX) and porosity analysis (BET). The thermal analysis showed that the majority of organic compounds derived from the synthesis is eliminated up to 700ºC. The XRD results showed that the samples crystallized as Fm3m cerianite single phase when they are calcined at 700ºC. When calcined at 1000ºC the sample is monophasic up to y=0.05. For $y \geq 0.1$ the secondary phase, $Gd_2Ti_2O_7$ (s.g. Fd3m), was observed (Fig.1). The analysis by EDX confirmed the nominal composition for all samples (Tab.1). The textural analysis of samples treated at 700ºC showed that they are a mesoporous solid, but a significant loss of the porosity was observed when calcined at 1000ºC. The MEV image confirmed such a result (Fig.2).

Table 1: Energy Dispersive X-ray (EDX) and Surface Area (BET) of ~~ceramic~~ $[(CeO_2)_{0.8}(GdO_{1.5})_{0.2}]_{1-y}(TiO_2)_y$ with 0<y<0.1, calcined at 700ºC.

Material	**Y (%Ti Nominal)**	**EDX (Atomic %)**			**$S_{BET}(m^2/g)$**
		Ce	**Gd**	**Ti**	
GDC:Ti0	0.000	0.8052	0.1948	-	4.5858
GDC:Ti2.5	0.025	0.7942	0.1829	0.0229	11.6679
GDC:Ti5	0.050	0.7727	0.1780	0.0490	15.7300
GDC:Ti10	0.100	0.7281	0.1713	0.1006	16.5050

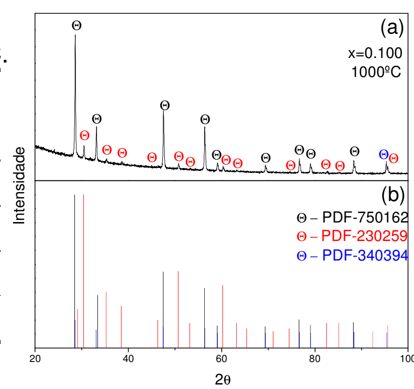

Figure 1: (a) XRD diffraction patterns of the sample annealed at 1000ºC with y=0.100 and (b) Powder Diffraction File (PDF) of gadolinium-doped cerium (black), gadolinium titanate (red) and cerium oxide (blue).

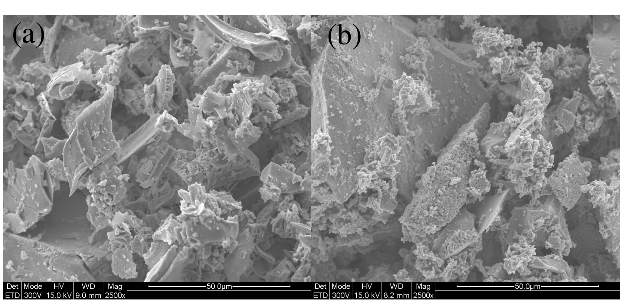

Figure 2: MEV image of samples with y=0,100, calcined at (a) 700°C and (b) 1150ºC.

References

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