SUPPORTING INFO

High-surface-area 3D Ordered Mesoporous Oxides for Continuous Operation in High Temperature Energy Applications


CGO Phase Purity:

Figure S1 presents the X-ray diffraction (XRD) patterns of the CGO mesoporous powders synthesized and calcined at T = 600 ºC after template removal. The indexed peaks correspond to a cubic fluorite structure of Ce₀.₈Gd₀.₂O₁.₉ (s.g. Fm₃m) with lattice parameter a = 5.423(2) Å (as determined by Le Bail fits). Pure CGO single phase was obtained as shown by XRD (JCPDS 75-0162) and corroborated by Raman spectroscopy (not presented here).

![XRD pattern of CGO as synthesized at T = 600 ºC. Diffraction peaks corresponding to the cubic fluorite with space group Fm3m are labeled.](image)

**Figure S1** XRD pattern of CGO as synthesized at T = 600 ºC. Diffraction peaks corresponding to the cubic fluorite with space group Fm3m are labeled.

**Structural Characterization of the Thermal treated CGO Mesoporous Samples**

Figure S2 shows in more detail the results obtained from the structural characterization of the CGO mesoporous oxides after the stability tests. Figure S2a presents the X-ray diffraction (XRD) patterns of the thermal treated powder (CGO-600-800, -900, -1000 for 24 h). Pure CGO single phase was obtained for all the samples under studied. Figure S2b shows the nitrogen adsorption-desorption isotherms of the mesoporous samples used to determine the BET, pore volume and micropore area values shown in Table 1.
Figure S2 Structural characterization of 24 h thermal treated mesoporous CGO-600 at different temperatures (CGO-600, -800, -900, -1000 24 h). (a) XRD patterns. (b) Nitrogen adsorption-desorption isotherms.

CGO Microporosity Reduction:

Figure S3 shows the TEM images of the mesoporous CGO as synthesized at 600 °C and after the stability test at 800 °C after 24 hours in air. The inset figures show the surface flattening and the microporosity reduction taken place after increasing the temperature of the long stability measurements.

Figure S3 TEM images of the mesoporous CGO as (a) synthesized at 600 °C. (b) After the stability test at 800 °C after 24 hours in air. The insets show a detail of the mesoporous particles.

Williamson-Hall Plot:

Figure S4 shows the Williamson-Hall plot for CGO replica stabilized at 600 °C. By using equation (1), this plot was used to determine the average grain size and micro-strain.
Figure S4 Williamson-Hall plots of CGO as synthesized at T = 600 ºC. The reflections used for determine each data point is labeled.

**Microstrain**

Figure S5 presents the evolution of the microstrain with time for the CGO-600 during the isothermal stability tests at 800, 900, 1000, 1100 ºC.

Figure S5. Microstrain evolution with time of the CGO sample calcined at 600 ºC during isothermal stability tests at 800, 900, 1000, 1100 ºC.

**Oxidation/Reduction Cycles in the TGA-Setup**

Figure S6 shows the oxidation and reduction cycles designed for the experiment in the TGA, to quantify the degree of the CGO reduction.
Figure S6. Oxidation/Reduction cycles of the CGO-600 after the isothermal stability tests at 800 ºC (CGO-600-800-24h) during 24 h and of the sample CGO-600 after the isothermal stability tests at 1000 ºC during 5 h (CGO-600-1000-5h).

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