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Novel Grain-Boundary Ion-Conducting Booster Phase for Gd-Doped Ceria Oxides

Henrique Tidei[1]; Rubens M. Nascimento[2]; João Grilo[1]

1. Department of Materials and Ceramic Engineering - DEMaC/CICECO, University of Aveiro, 3810-193 Aveiro, Portugal

2. Postgraduate Program in Materials Science and Engineering - PPGCEM , Federal University of Rio Grande do Norte, Natal 59078-970, Brazil

Context

Solid Oxide Fuel Cells (SOFCs):
directly convert chemical energy into electricity, offering high efficiency and fuel flexibility.

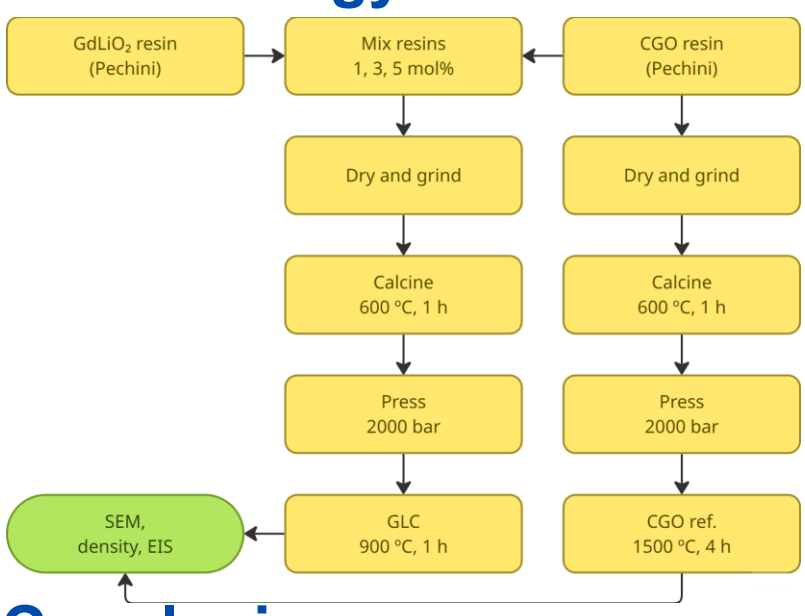
Gadolinium-Doped Ceria (CGO):
is a promising SOFC electrolyte, where Gd^{3+} doping promotes oxygen vacancies and ionic conduction.

Grain Boundary:
Despite its high bulk ionic conductivity, CGO exhibits significant resistance at grain boundaries. The formation of space-charge layers, associated with oxygen-vacancy depletion near these interfaces, can hinder ionic transport and increase the overall electrolyte resistance.

Objectives

- Promote the formation of a $GdLiO_2$ phase in CGO (1, 3 and 5 mol.%) to densify the electrolyte at 900 ºC;
- Evaluate its effect on the electrical response, with focus on the grain boundaries.

Methodology



Conclusions

- $GdLiO_2$ enables dense CGO (94-96%) at 900 ºC, about 600 ºC below the conventional temperature;
- Total conductivity rises 9 - 23 times at 250 ºC, driven by the grain boundary;
- The effect is non-linear with concentration, with the best response at 5 mol.%.

Results and Discussion

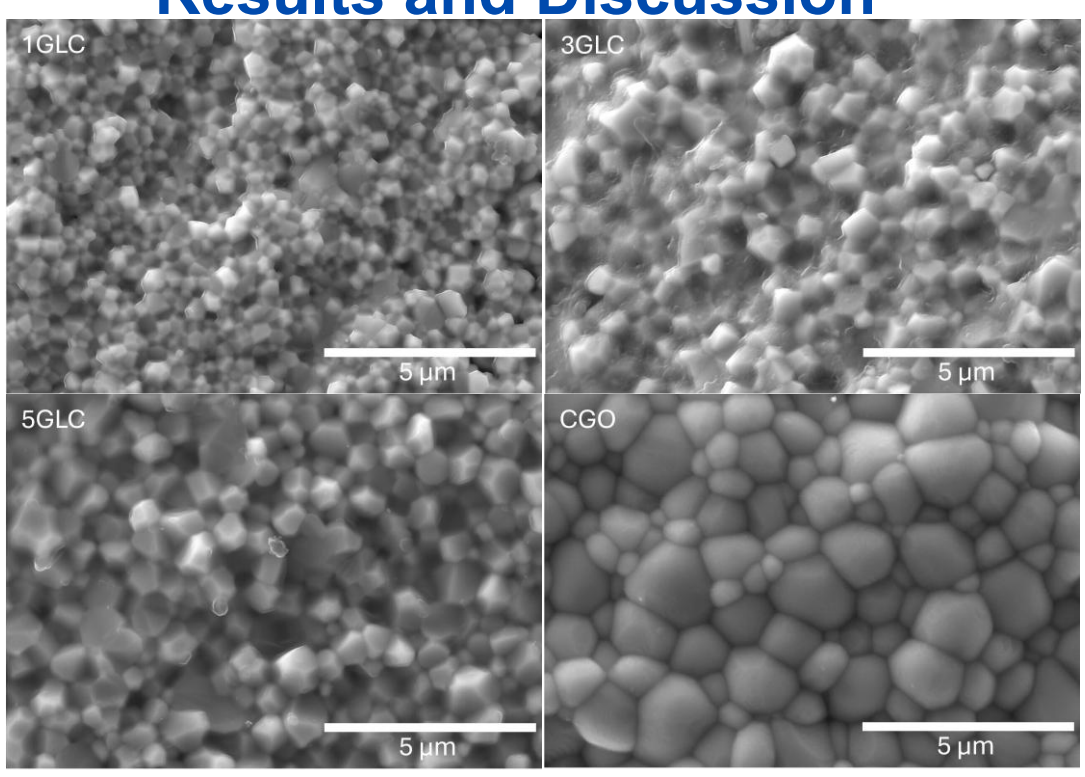


Figure 1. SEM images of fracture surfaces of 1GLC, 3GLC and 5GLC sintered at 900 ºC for 1 h, and of CGO sintered at 1500 ºC for 4 h.

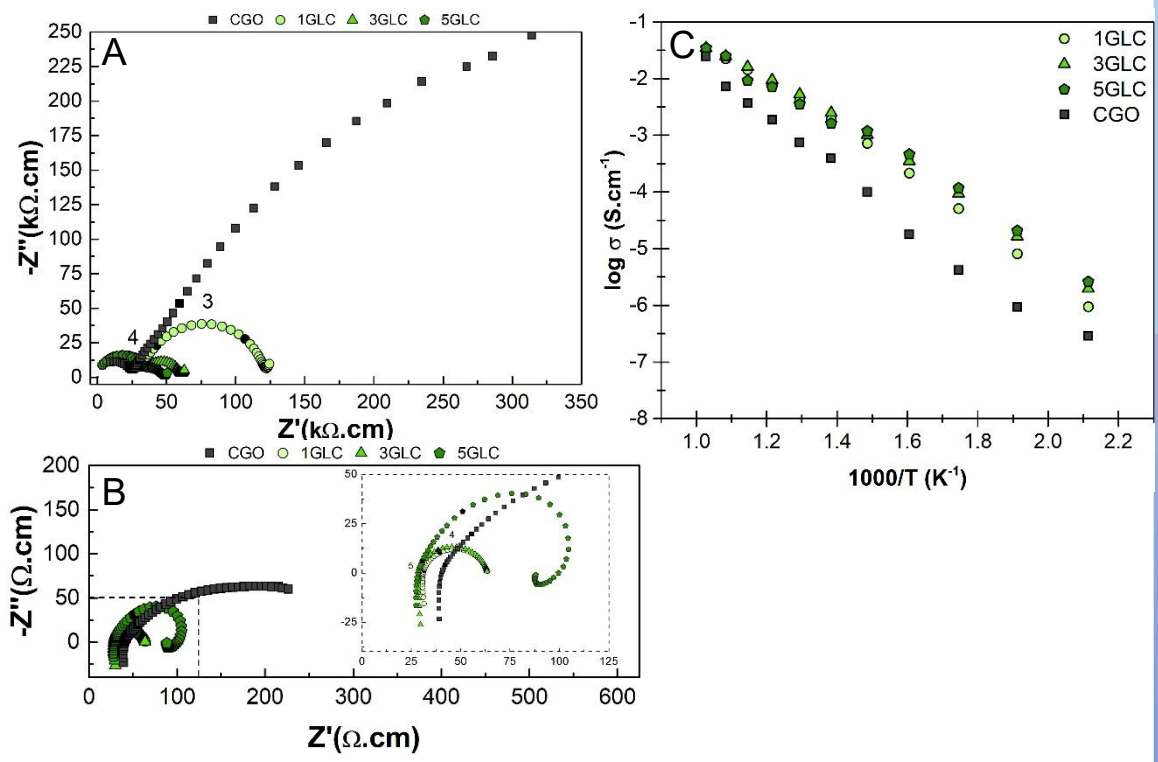


Figure 2. Nyquist plots at 250 ºC (A) and 700 ºC (B) and Arrhenius plot (C) for the same samples.

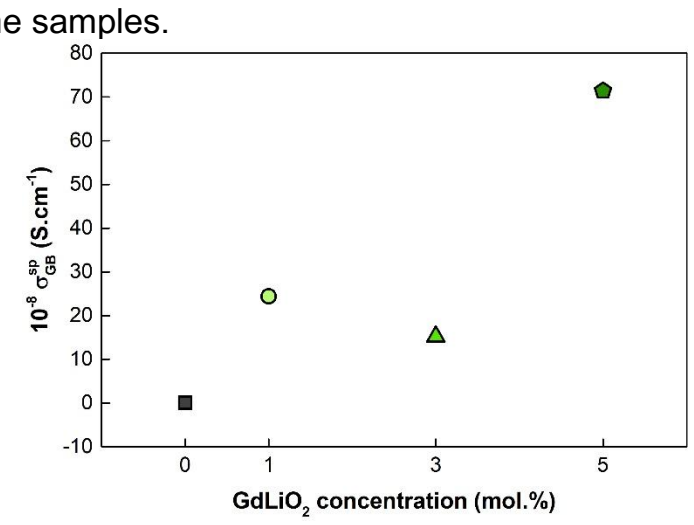


Figure 3. Specific grain-boundary conductivity at 250 ºC as a function of $GdLiO_2$ concentration (0 mol.% = CGO).

References and acknowledgements

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