Abstract
Planar solid oxide fuel cells (SOFC) with CuO/gadolinium-doped ceria (GDC) supporting anode were produced and tested in H\textsubscript{2} and in CH\textsubscript{4}/CO\textsubscript{2} mixture at 650°C. The electrolyte densification at 900°C was promoted by compressive strains induced by larger anodic thickness. The reduction behaviour of CuO/GDC anodic powders was preliminarily evaluated. The electrochemical measurements showed an increasing power density with the anode thickness (from \(\approx 500\ \mu\text{m}\) to \(\approx 1.4\ mm\)) reaching a maximum value of 227 mWcm\(^{-2}\) at 650°C in pure \(\text{H}_2\). Power density of 29 mW cm\(^{-2}\) was measured in wet CH\textsubscript{4}/CO\textsubscript{2} biogas mixture at 650°C. Catalytic activity measurements toward methane dry reforming showed limited conversion at all investigated temperatures, this suggesting that the actual anodic reaction is the methane combustion. Scanning electron microscope observations and energy dispersive X-ray analyses of the cell tested in CH\textsubscript{4}/CO\textsubscript{2} mixture did not show any carbon deposit, thus pointing out that the Cu/GDC cermet can be considered a stable and reliable anodic substrate for IT-SOFC fed by CH\textsubscript{4}/CO\textsubscript{2} mixture.

Keywords: Copper-based anode; Gadolinia-doped Ceria; planar intermediate temperature solid oxide fuel cell; co-sintering; electrochemical impedance spectroscopy
4 Conclusions

Planar CuO-containing GDC anode and Li-doped GDC-based electrolyte were produced by tape casting and co-sintering.
Larger anode/electrolyte thickness ratio was shown to have a positive influence on SOFC performance because of the better electrolyte densification promoted by compressive stresses generated upon sintering because of the differential anode/electrolyte shrinkage.
The electrochemical characterization revealed in fact that the power density in H₂ increases with the anode thickness, reaching 227 mW cm⁻² at 650 °C for 1.4 mm thick anode.
The anodic powder catalytic activity determination pointed out that GDC promotes complete methane combustion and Cu is unable to activate the C-H bond of methane, this being advantageous for limiting the presence of carbon deposits. The cell with better microstructure (i.e., denser electrolyte) was tested by using wet CH₄/CO₂ biogas mixture at 650°C and power density of 29 mW cm⁻² was measured. The low power outputs in biogas suggest the need of further anodic composition optimisations in order to produce more acceptable performances.
The results obtained in the present work point out that Cu/GDC cermet can be considered as reliable anodic substrate for IT-SOFC fed by H₂ and/ or biogas.

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