



## Distinguishing the CO<sub>2</sub> electro-catalytic reduction pathway on modified Ni/GDC electrodes for the SOEC H<sub>2</sub>O/CO<sub>2</sub> co electrolysis process

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### ABSTRACT

High temperature co-electrolysis of H<sub>2</sub>O/CO<sub>2</sub> mixtures using Solid Oxide Cells has been proposed as a promising technology to produce synthesis gas (H<sub>2</sub> + CO), which can be processed further towards synthetic hydrocarbon fuels production [1, 2]. Co-electrolysis is a significantly more complicated process than steam electrolysis, because three reactions take place simultaneously; namely H<sub>2</sub>O electrolysis, CO<sub>2</sub> electrolysis and the catalytic Reverse Water Gas Shift reaction (RWGS) [1, 3]. Specifically, there are discrepancies whether CO is produced via the RWGS solely and that no electrolysis of CO<sub>2</sub> occurs, or if CO is produced both via the RWGS and via electrolysis of CO<sub>2</sub>. As a result, it is crucial to quantify the degree of CO production for each reaction [1, 3].

Modified X-Ni/GDC electrodes (where X = Au, Mo and Fe) have been studied [1], in the form of half-electrolyte supported cells, for their performance in the RWGS through catalytic-kinetic measurements. The samples were tested at open circuit potential conditions in order to elucidate their catalytic activity towards the production of CO ( $r_{CO}$ ). The first results revealed that Fe and Mo modification enhances the catalytic production of CO, in the whole studied temperature range (800-900 °C), reaching the thermodynamic equilibrium [1].

The presented study presents recent results from the electrocatalytic investigation on full electrolyte-supported cells. The derived catalytic profile of the electrodes [1] is used as a reference towards the distinction of the electro-catalytic pathway for the CO<sub>2</sub> reduction. Specifically, it is examined whether co-electrolysis is mainly catalytically/thermodynamically driven or it is a combination of electro- and catalytic processes. Physicochemical characterization is also presented, in which the samples were examined both in the form of powders and as half cells with BET, H<sub>2</sub>-TPR, Air-TPO and TGA re-oxidation measurements in the presence of H<sub>2</sub>O.

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