**EFFECT OF *P*H2 AND OF THE *P*H2O/*P*CO2 RATIO ON THE CO ORIGIN AND THE OCCURING ELECTRO-CATALYTIC INTERACTIONS ON Ni/GDC DURING H2O/CO2 CO-ELECTROLYSIS**

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**ABSTRACT**

Η2Ο and CO2 can be converted to valuable syngas (H2 + CO) through high temperature solid oxide electrolysis cells (SOECs). In this way renewable electrical energy is stored in the form of chemical energy (Η2Ο, CO2) and syngas can be processed further to produce other fuels.

During the H2O/CO2 co-electrolysis, the fuel SOEC electrodes meet a complex environment, where catalytic reactions (e.g. the reverse water gas shift, RWGS) are coupled with electrochemical processes (i.e. Η2Ο and CO2 electrolysis). The extent of each reaction determines the composition of the products, i.e. H2/CO ratio. Up today, there are various H2O/CO2 co-electrolysis scenarios about the extent of CO production, resulting from the RWGS reaction and/or the CO2 electrochemical reduction.

The study presents a holistic methodology for the discrimination of the contribution of H2O and CO2 electrolysis reactions, as well as of the RWGS, on the production rate of CO during the solid oxide H2O/CO2 co-electrolysis process. The investigation took place on an electrolyte supported cell with Ni/GDC as the fuel electrode, at 800−900 oC, by applying various *P*Η2Ο/*P*CO2 feed ratios, in the range of 0 ≤ *P*Η2Ο/*P*CO2 ≤ 1, and two *P*Η2 values (2 and 21 kPa). Critical combination of physicochemical and electrochemical characterization with electrocatalytic measurements and quantitative analysis of products highlighted a competitive adsorption and electro-reduction between H2O and CO2 on Ni/GDC. Moreover, it is confirmed that the H2O/CO2 co-electrolysis process is determined by: (i) *P*Η2Ο/*P*CO2 ratio and (ii) *P*H2. Specifically, at *P*Η2Ο/*P*CO2 = 1 and high *P*Η2 = 21 kPa the adsorption of H2O is favoured, compared to CO2, and the electrochemical process is 100% selective towards the electrolysis of H2O. The CO production is catalytically controlled by the RWGS reaction. The electrochemical reduction of CO2 occurs at *P*Η2Ο/*P*CO2 = 0.3, in combination with H2O electrolysis and the RWGS, whereas its contribution is enhanced by decreasing the *P*Η2Ο and *P*Η2 [1].

**KEYWORDS:** Solid Oxide H2O/CO2 co-electrolysis, Ni/GDC, Competitive electro-reduction, CO production pathway,

RWGS contribution

**REFERENCES**

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