**Finding the optimum loading of Au & Mo in NiO/GDC and the influence of Fe for the reversible operation of solid oxide cells**

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**ABSTRACT**

Reversible solid oxide cells (rSOCs) are ideal candidates for renewable energy storage and usage, due to their ability to work under electrolysis mode for H2 production or fuel cell mode for power generation, both by the same unit. Operation of SOCs at high-temperatures enables high energy efficiency, increases reaction rates and allows the use of low-cost catalysts compared to low temperature technologies. The state-of-the-art (SoA) fuel electrodes: Ni/YSZ and Ni/GDC, despite their advantages, are prone to various degradation phenomena, such as Ni coarsening, agglomeration, and depletion/migration. One way to mitigate these issues is by dispersing small amounts of transition metal additives, either non-noble or noble elements, in the Ni-based electrode[1].

This study presents the optimization efforts on the already developed 3wt.% Au–3wt.% Mo-NiO/GDC electrode[1], with the primary objective to decrease the Au loading, then to determine the optimum value of the Au/Mo ratio and if possible to replace Au and Mo with Fe. With this in mind, several electrocatalysts were synthesized, with different Au and Mo loadings, and then evaluated under r-SOC operation. The electrochemical characterization was conducted by means of i-V curves and Electrochemical Impedance Spectroscopy (EIS) analysis, in order to ascertain the effect of three different parameters, such as the: (i) temperature in the range of 900-800oC, (ii) reaction mixture and (iii) reversible operation (i.e. SOFC/SOEC cycles).

The experimental data showed that the modification of the SoA NiO/GDC electrode with Au and Mo has a positive effect on the polarization resistance (Rpol) of the cell (decreased value and higher stability). On the other hand, further increase in the amount of Mo, beyond a certain wt.% loading, caused a steep increase of the ohmic resistance (Rohm) value, which is accompanied by a drop in the performance of the cell. Overall, the electrode with the lowest loading in Au (1wt.% Au–3wt.% Mo-NiO/GDC) exhibited the best and most stable performance under reversible SOC operation. In addition, preliminary results revealed a significant enhancement of the Ni/GDC r-SOC performance, by replacing Mo with Fe.

**KEYWORDS:** rSOC, Modified Ni/GDC, Optimization, Au-Mo & Au-Fe Synergy

**REFERENCES**

[1] C. Neofytidis, E. Ioannidou, L. Sygellou, M. Kollia, and D. K. Niakolas, “Affecting the H2O electrolysis process in SOECs through modification of NiO/GDC; experimental case of Au-Mo-Ni synergy,” *J. Catal.*, vol. 373, pp. 260–275, 2019.