DEVELOPMENT OF $Sr_2Fe_{1,5}Mo_{0,5}O_{6-\delta}$ BASED SOLID OXIDE ELECTROLYSIS CELLS

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Hydrogen electrodes of solid oxide electrolysis cells (SOEC) are typically made of Ni-YSZ cermet. Despite having excellent catalytic activity Ni-based electrodes suffer from poor redox stability and Ni volatility [1]. $Sr_2Fe_{1,5}Mo_{0,5}O_{6-\delta}$ (SFM) mixed ionic- and electric conducting (MIEC) double perovskite has been proposed as promising hydrogen electrode material for solid oxide electrolysis cells (SOEC). In this study SOEC single cells were prepared using SFM hydrogen electrode and $(La_{0,6}Sr_{0,4})_{0,99}Co_{0,96}Ti_{0,04}O_{3-\delta}$ (LSCT) as well as $(La_{0.6}Sr_{0.4})_{0.95}Co_{0.2}Fe_{0.8}O_{3-\delta}$ (LSCF) air electrodes [2, 3].

Studied cells were prepared using 19 mm 10Sc1CeSZ electrolyte substrates. Screen printed 6 µm thick $Ce_{0.9}Gd_{0.1}O_{1.95}$ (GDC) layer was applied to both sides of the cell to prevent formation of insulating $SrZrO_3$ layer. GDC layer was sintered to the electrolyte at 1300°C for 5h. SFM or 50%SFM/50%GDC electrode layer with 0,52cm^2 surface area was screen printed to the GDC layer and was sintered at 1200°C. Afterwards LSCT or LSCF oxygen electrodes were screen printed to the other side of the cell and sintered at 1100°C for 2 h. Finally, cells were characterized using electrochemical impedance spectroscopy (EIS), scanning electron microscopy (SEM) and time-of flight secondary ion mass spectrometry (TOF-SIMS).

Impedance spectroscopy analysis showed that cells with 50%SFM/50%GDC hydrogen electrode and LSCT oxygen electrode had highest current densities, reaching 1,59 A/cm^2 at 1,5V and 850°C with 67,5% water in hydrogen electrode compartment. With TOF-SIMS analysis it became apparent that Sr is moving through GDC intermediate layer and poorly conducting phases are formed in the GDC/10Sc1CeSZ boundary.

[1] S.C. Singhal, K. Kendall (Eds.), High-Temperature Solid Oxide Fuel Cells: Fundamentals, Design and Applications, Elsevier, Oxford, 2003.

[2] L. Bernadet, C. Moncasi, M. Torell, A. Tarancon, High-performing electrolyte-supported symmetrical solid oxide electrolysis cells operating under steamelectrolysis and co-electrolysis modes, Int. J. Hydrogen Energy 45 (2020)14208–14217

[3] C. Sanna, W. Zhang, P. Costamagna, P. HoltappelsSynthesis and electrochemical characterization of electrospun nanofiber cathodes for intermediate- temperature solid oxide fuel cells Int. J. Hydrog. Energy (2020), pp. 1-14

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