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Enhanced Long Term Durability of Metal-Supported Solid Oxide Electrolysis Cells By Advanced Coatings

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Abstract

Metal-supported solid oxide electrolysis cells (MS-SOECs) with symmetric cell architecture were developed for high temperature electrolysis at Lawrence Berkeley National Laboratory (LBNL). The cell is comprised of a thin ceramic electrolyte and porous electrode backbones sandwiched between stainless steel metal supports. MS-SOECs offer a number of advantages over conventional all-ceramic SOECs due to their low-cost structural materials (e.g. stainless steel), mechanical ruggedness, excellent tolerance to redox cycling, and extremely fast start-up capability. The current density of MS-SOEC at 1.3 V and 50 vol% steam content is improved by optimizing microstructure of electrode backbone and procedure of catalyst infiltration. MS-SOEC with composite LSCF-SDC air electrode catalyst displays a degradation rate of 1.6%/100 h with current density of 0.33 A cm^{-2} at 700 °C in 1000 h test (Figure 1). Post-mortem analysis reveals that the degradation is caused by the primary modes of fuel electrode catalyst coarsening and Cr poisoning on air electrode catalyst, and secondary modes of metal support oxidation and local elemental accumulation of Ni. In an effort to suppress Cr migration thereby improving long term durability, advanced coatings, such as CoO_x, $NiFe_2O_4$, $(Co,Mn)_3O_4$, etc., are applied to the cathode-side support by atomic layer deposition or electrodeposition. The impact of coating composition and deposition method will be reported.

Figure 1. Durability of the cell with LSCF-SDC air electrode catalysts at constant current of 0.33 A cm^{-2} and 700 °C, with 50 vol% H_2-50 vol% H_2O.

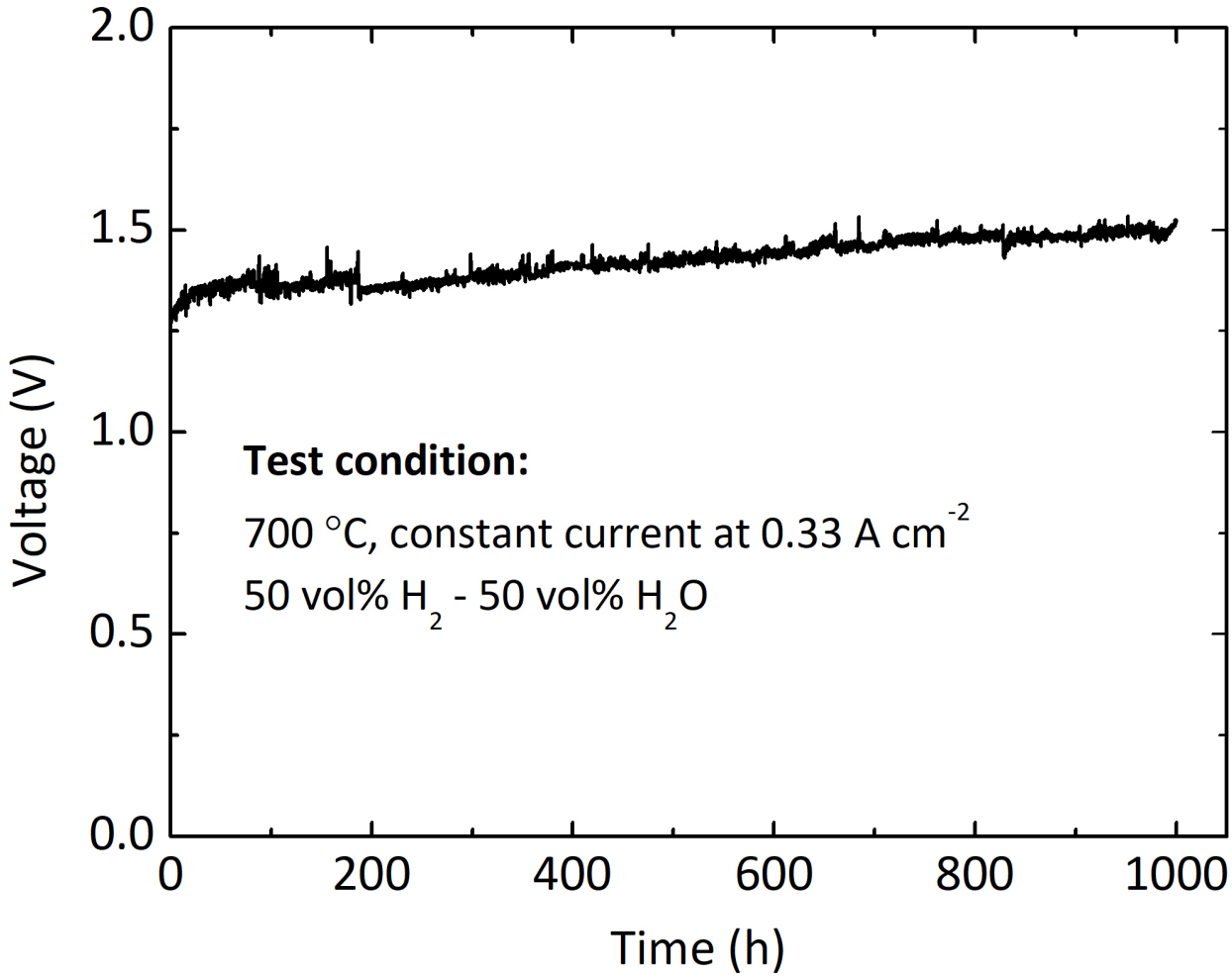

Figure 1

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