Three dimensional characterization of nickel coarsening in solid oxide cells via ex-situ ptychographic nano-tomography

Nickel coarsening is considered a significant cause of solid oxide cell (SOC) performance degradation. Therefore, understanding the morphological changes in the nickel-yttria stabilized zirconia (Ni-YSZ) fuel electrode is crucial for the wide spread usage of SOC technology. This paper reports a study of the initial 3D microstructure evolution of a SOC analyzed in the pristine state and after 3 and 8 h of annealing at 850 °C, in dry hydrogen. The analysis of the evolution of the same location of the electrode shows a substantial change of the nickel and pore network during the first 3 h of treatment, while only negligible changes are observed after 8 h. The nickel coarsening results in loss of connectivity in the nickel network, reduced nickel specific surface area and decreased total triple phase boundary density. For the condition of this experiment, nickel coarsening is shown to be predominantly curvature driven, and changes in the electrode microstructure parameters are discussed in terms of local microstructural evolution.

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