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ELECTROCHEMICAL POTENTIAL SIMULATION OF SOLID OXIDE FUEL CELL CONSIDERING PHASE TRANSFORMATION OF ZIRCONIUM OXIDE

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Components of Solid Oxide Fuel Cells (SOFCs) are always exposed to high temperature and large gas pressure under operation, which leads electrochemical degradation. Especially, the phase transformations induced by the precipitation of Ni in Ni-doped 8Yttria-Stabilized Zirconia (8YSZ) under operation have recently been known to cause the electrochemical degradation of SOFC [1,2]. It is therefore important to evaluate the oxygen potential distribution in 8YSZ to predict the degree of degradation during long-term operations. In this study, the evolution equations of the electric conductivities of oxygen ion and electron are formulated, and are used for the electrochemical simulations using reaction-diffusion equations of electrochemical potentials of oxygen ion and electron. Since the phase transformation changes the cubic crystal structure of 8YSZ into the tetragonal one under reduction atmosphere, the time constants, which determine the duration of degradation process, are changed accordingly before and after transformation. As the result, it is shown that the proposed evolution equations enable us to characterize the temporal deterioration in 8YSZ in terms of the electric conduction under SOFC operations. The effects of the gas concentrations in the paths of SOFC on the phase transformation are also investigated.

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