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Calculating Approach of Thermal Conductivity of 8 YSZ in Different Relative Humidities Corresponding to Low Water Contents

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Abstract : This study focuses on the calculating approach of the thermal conductivity of 8 mol% yttria-stabilized zirconia (8YSZ) in different relative humidity corresponding to low water contents. When water content in 8YSZ is low, water droplets can accumulate in the neck regions. We assume that spherical water droplets are randomly located in the neck regions formed by grains and surrounded by the pores. Based on this, a new hypothetical pore constituted by air and water is proposed using the microstructural modeling. We consider 8YSZ is a two-phase material constituted by the solid region and the hypothetical pore region where the water droplets are penetrated in the pores, randomly. The results showed that the thermal conductivity of the hypothetical pore is calculated using the parallel resistance for low water contents, and the effective thermal conductivity of 8YSZ material constituted by solid and hypothetical pore in different relative humidities using EMPT. When the numbers of water layers on the surface of 8YSZ are less than 1.5, the proposed approach gives a good interpretation of the experimental results. When the theoretical value of the number of water layers on 8YSZ surface is 1, the water content is not enough to cover the internal solid surface completely. The proposed approach gives a better interpretation of the experimental results in different relative humidities that numbers of water layers on the surface of 8YSZ are less than 1.5.

Keywords : 8YSZ, microstructure, thermal conductivity, relative humidity
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