Failure Analysis of Porous Solid Oxide Fuel Cells by Using Peridynamics

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Solid oxide fuel cell (SOFC) is widely used in hybrid marine propulsion systems due to its high power output, excellent emission control and wide fuel suitability. However, the redox reaction of hydrogen and oxygen ions generates large amount of heat which increases the operation temperature of SOFC to $800-1000℃$. Under such operation temperature, the delamination and degradation may occur in the electrodes and electrolyte. As a result, unstable voltage, low capacity and cell failure may eventually occur.

Hence, this study presents failure analysis of a porous SOFC cell plate which contains electrodes, electrolytes and pores. A microscale specimen of the plate is selected in order to maintain uniform thermal loading and increase the accuracy of estimation. A new computational technique, peridynamics, is utilized to calculate the deformations and stresses of the cell plate. Moreover, the crack formation and propagation are also obtained by using peridynamics.