Thermally and Electrochemically Promoted Cathode/Electrolyte Interfaces in Solid Oxide Fuel Cells

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The interfaces between cathode and electrolyte in solid oxide fuel cells (SOFCs) play a critical role in the overall performance and durability. The electrode/electrolyte interface in SOFCs is generally formed by pre-sintering at high temperatures, e.g., ~1400 ^{o}C in the case of Ni-Y_2O_3-ZrO_2 (YSZ) cermet anodes and ~1150 ^{o}C for $La_{0.8}Sr_{0.2}MnO_3$ (LSM) cathodes[1]. In the case of LSM cathodes, the electrode/electrolyte interface is characterized by the formation of contact rings on the YSZ electrolyte. However, high temperature sintering raises the problem of possible reactions between electrode and electrolyte. Thus applying the electrode directly onto the electrolyte without further sintering is an effective approach to address this issue, and the intimate interface is promoted by polarization[2]. Here the interface between LSM and YSZ and Gd-doped ceria (GDC) electrolytes formed under high temperature sintering as well as under cathodic polarization is studied using Focused Ion Beam (FIB) and Transmission Electron Microscope (TEM) techniques. The atomic-level high resolution TEM reveals the lattice structures of each phase that meet and interact at the interface region, indicating good interfacial adhesion. Also, the appearance of lattice misorientation and misfit dislocations in adjacent to the interface regions of both LSM/YSZ and LSM/GDC cells was identified, which accommodates the lattice mismatch of two heterogeneous phases to minimize the interface free energy[3, 4]. Comparable interfaces induced thermally and electrochemically are characterized, implying that cathodic polarization is a feasible and efficient way to promote the good interface between cathode and electrolyte.

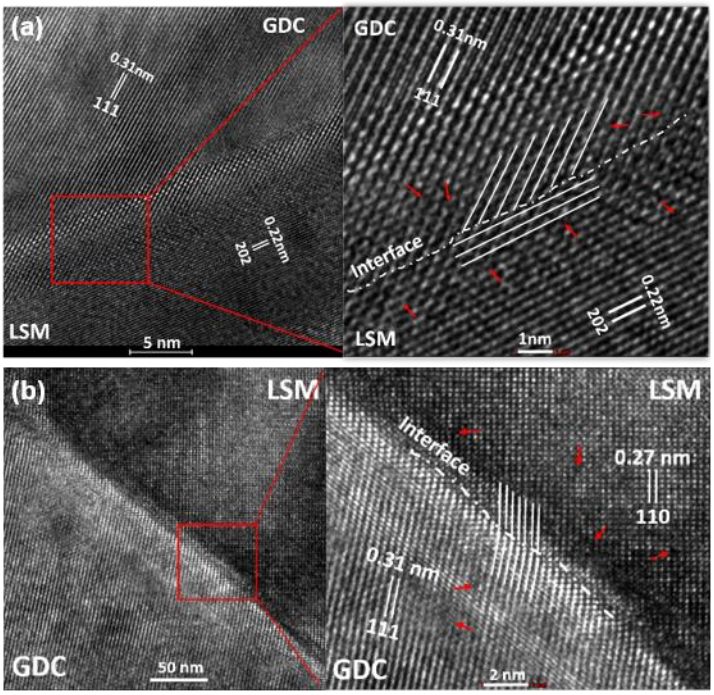

Figure 1. High resolution TEM of LSM/GDC interface induced by (a) high temperature sintering and (b) polarization.

References

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