Oxidation Protective Coating on Ferritic Interconnect by Nanocrystalline Perovskite Thin Films

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The search for the new energy supply has been driven by both the awareness of environmental factors and limited energy resources. Compared to the fossil and nuclear sources, the new energy technologies must be cleaner, cheaper, smaller and more efficient, such as fuel cells and solar cells. The development of solid oxide fuel cells (SOFCs) has been extensively performed over past several years. The key factor lies in the heart of commercializing SOFCs is to lower the overall cost either per kW or kg. One of the solutions is to reduce the operation temperature at the intermediate temperature regime (500 – 700ºC) so that metallic alloy can be used as the interconnect, which offers not only a lower cost than that of chromite interconnect, but also ductility and ease for fabrication. Ferritic alloys are being considered as IT SOFC interconnect candidates. In comparison with the self-oxidation scale of Cr_2O_3, oxidation resistant coating can allow a better adhesion, higher conductivity, and an improved thermal and mechanical stability. It is our intent to report results of coating E-brite alloy with nanocrystalline chromite thin films. Chromite was selected because of the stability

Spin coating was used to prepare nanocrystalline chromite thin films (Fig. 1) on the polished E-brite substrate with a suitable polymeric solution produced from a Modified Pechini method. The dense perovskite type chromites were formed at relatively low temperature of 600^oC. A much higher temperature ($\sim1500^oC$) is required to fabricate similar dense perovskite structure in bulk sample. Therefore, this low temperature process enables the study on the properties of chromite films used as high temperature oxidation (700-800^oC) protective coating.

Fig. 2 shows the grazing XRD patterns of ferrite and chromite films, both of which exhibit a perovskite type structure. Fig. 3 is a plot of areal specific resistance (ASR) vs. 1/T for E-brite without and with chromite coating. Note that at 800^oC, ASR value decreases more than an order for the specimen with chromite protective coating. The sample without chromite coating does have a Cr_2O_3 scale on the surface, which itself acts as high temperature oxidation resistant layer (Fig. 3). Chromite films thus can indeed significantly decrease the oxidation rate and improve the conductance of the scale conductivity. Further experiments have been performed to study the role of chromite composition, thermal cycle and gas environment on the transport and structural properties of chromite films.

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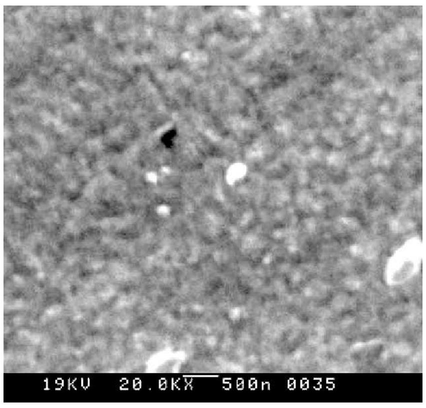

Fig. 1 Chromite film on E-brite substrate annealed at 600^oC.

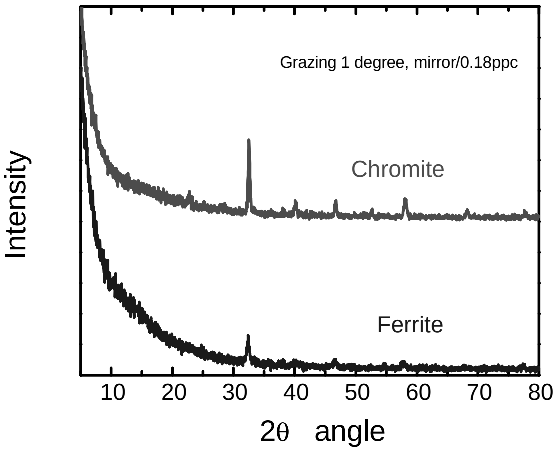

Fig. 2 XRD patterns of chromite and ferrite thin film annealed at 800^oC.

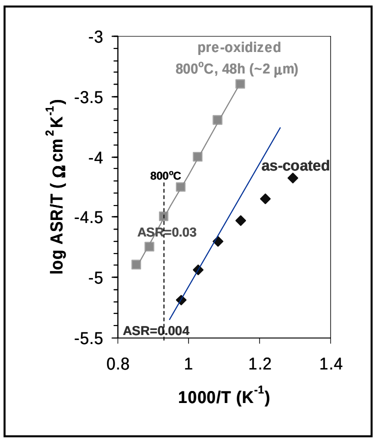

Fig. 3 A plot of areal specific resistance (ASR) vs. 1/T for E-brite without and with chromite coating. Note that at 800^oC, ASR value decreases more than an order for the specimen with chromite protective coating.