In-situ powder diffraction study of interconnect material for SOFCs

Beamlines: X14A

Technique: Powder Diffraction

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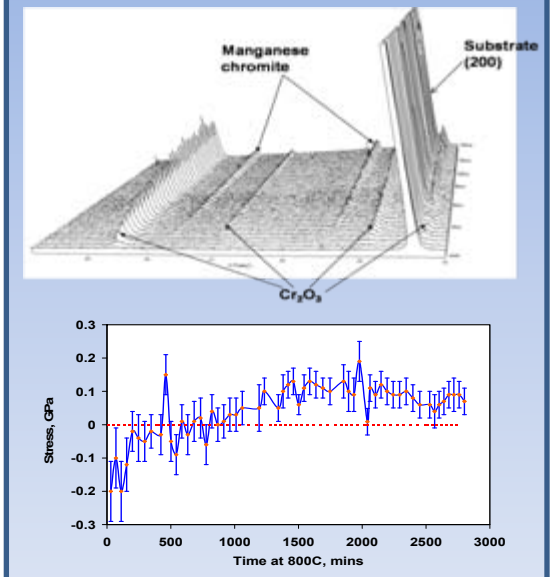
Motivation: The risk of failure of SOFCs will increase with the number of interfaces and the potential for debonding of these interfaces has raised concerns about its impact on the long-term performance of SOFCs. Interfacial debonding on the cathode region of SOFCs could be induced by stresses that arise from mismatches in thermoelastic properties, from phase transformations and/or from the formation of new phases –e.g., as a result of chemical reactions including oxidation. Knowledge about the origin of these stresses is essential for the development of models to predict the service life of SOFCs and to guide the development of more durable and reliable SOFCs.

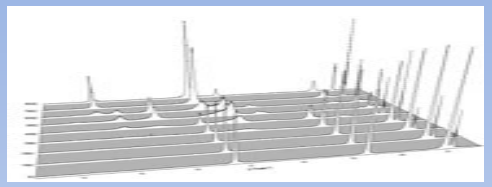
Conclusions:

- Bare SS441 metals are prone to oxidation process at 800°C, forming Cr_2O_3 and then manganese chromite.
- The growth stresses in Cr_2O_3 switched from compression to tensile as oxidation process continues
- Phase evolution of the $Mn_{1.5}Co_{1.5}O_4$ spinel coating layer during oxidation was studied. After 10 hours of exposure to air at 800 °C, no significant Cr_2O_3 was observed. The coating has slowed down the oxidation of the metal.

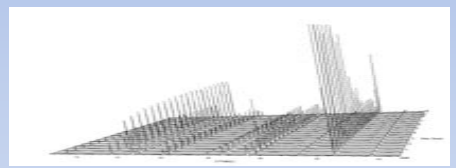
Thermally Growth Oxide on SS441 at 800 °C



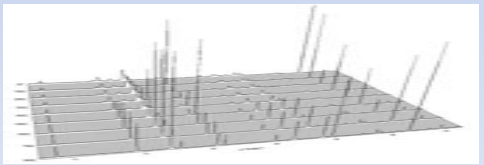
The stress of the Cr2O3 phase switched from compression to tensile after 24 hours of oxidation



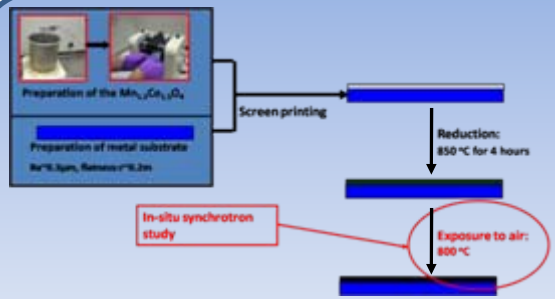
Upon reaching 800 °C, the $Mn_{1.5}Co_{1.5}O_4$ spinel coating transformed t cubic spinel phase ($MnCo_2O_4$). Transition oxidation states are from 400°C to 700 °C.



The cubic spinel phase persist after 10 hours of holding at 800 °C. No significant Cr_2O_3 phases were observed.



During cooling, the tetragonal spinel phase ($CoMn_2O_4$) precipitated out of the cubic phase. At RT, both phases were present



$Mn_{1.5}Co_{1.5}O_4$ spinel coating was applied to protect the me substrate from oxidation