The Effect of Spinel Coating Thickness on SOFC Interconnect Resistance

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Introduction

Ferritic stainless steels are preferred interconnect materials for intermediate temperature SOFCs because of their resistance to oxidation and low cost. However, they produce Cr-containing volatile species at SOFC operating temperatures, which can cause cathode poisoning. Electrically conducting spinel coatings have been developed to prevent cathode poisoning and to maintain an electrically conductive pathway through SOFC stacks. PNNL used Design of Experiment (DOE) methodology to achieve optimization of fabrication processes for dense thin spinel coatings. In current studies, coatings prepared using this optimized condition are being characterized with ASR and long-term spallation tests. The effect of thickness on ASR and spallation behavior is also under investigation. The results of this work demonstrate the possibility of automated mass production of dense conductive spinel-coated interconnect materials and give a standard thickness for obtaining stable long-term operation.

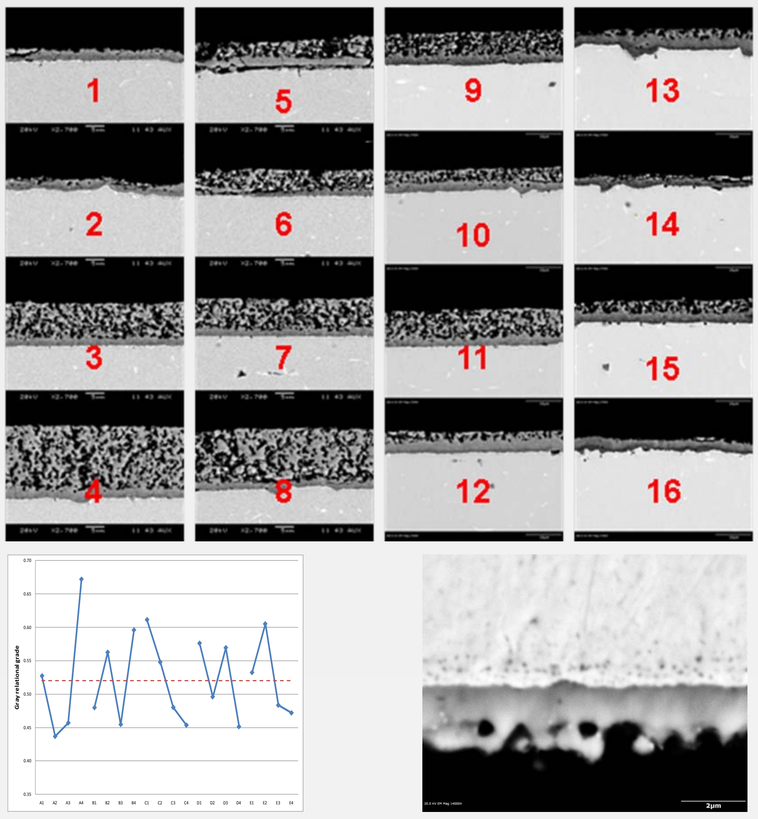
Objective

Prevent chromia species evaporation and maintain high electrical conductivity during long term operation at high temperature. Mitigate scale spallation and maintain stability during several thermal cycles.

Design of Experiment

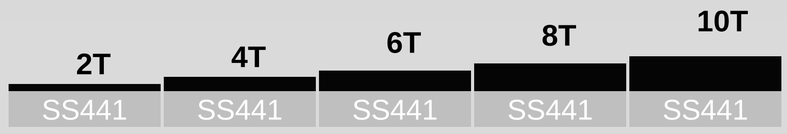
Factors and Levels

Factors	level1	level2	level3	level4
Viscosity	37 cP	17 cP	9 cP	5 cP
Coating speed	40mm/sec	60mm/sec	80mm/sec	100mm/sec
Head height	15mm	25mm	35mm	45mm
Ink feeding rate	0.5ml/sec	1ml/sec	1.5ml/sec	2ml/sec
Air flow rate	30ml/sec	40ml/sec	50ml/sec	60ml/sec

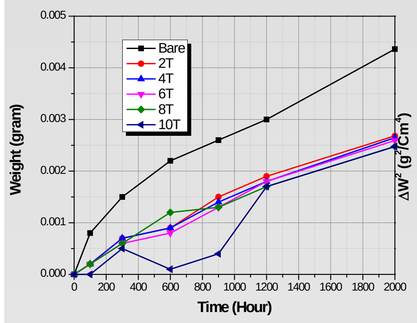


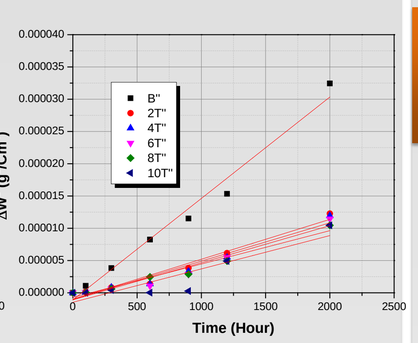
Thickness Experiment

Coating of Samples

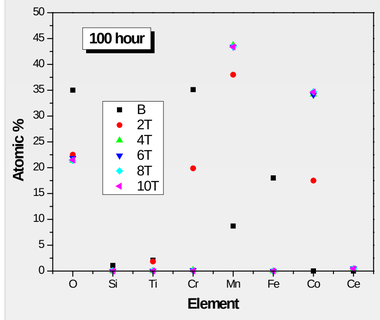


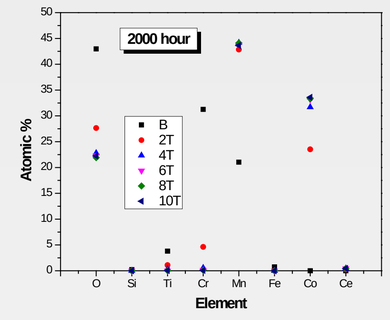
Reaction Kinetics

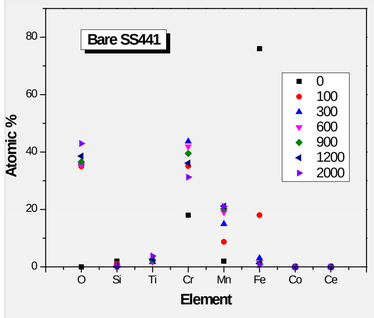


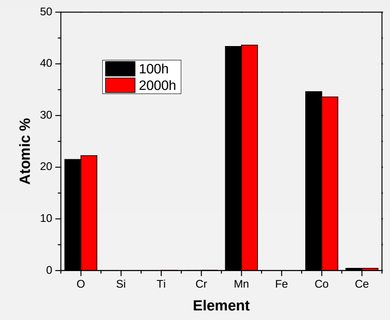


	ΔW^2 (Kp)	R^2
Bare	1.5720E-08	0.97724
2T	6.1828E-09	0.95459
4T	5.9367E-09	0.94447
6T	5.7523E-09	0.93385
8T	5.1718E-09	0.96003
10T	5.1683E-09	0.79158



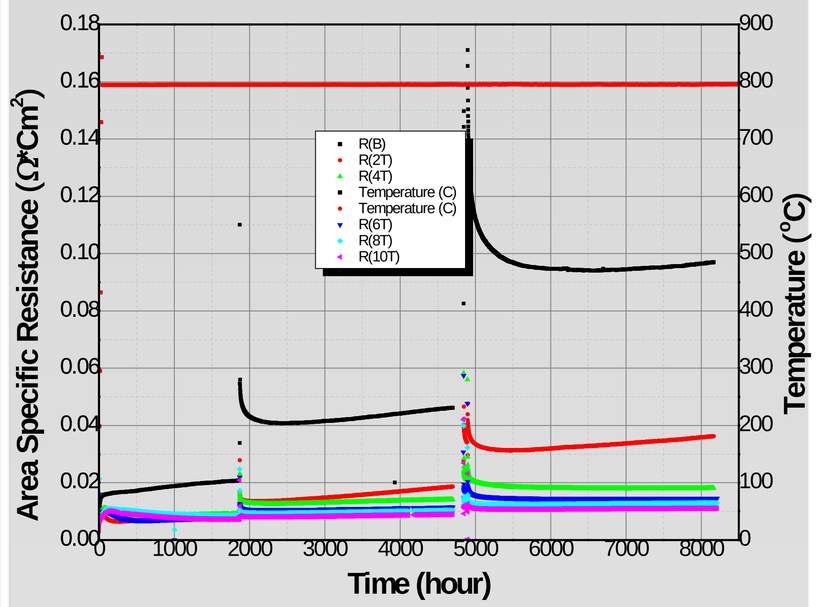




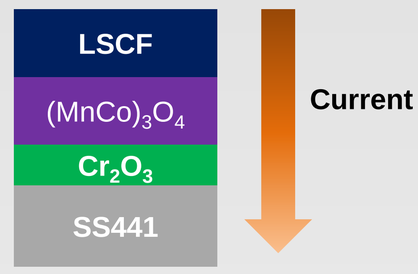


Area Specific Resistance

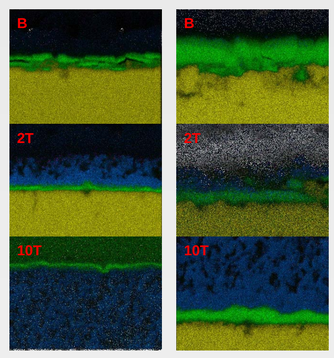
ASR result

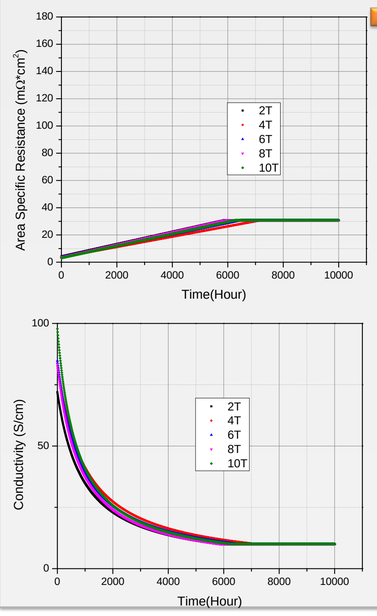


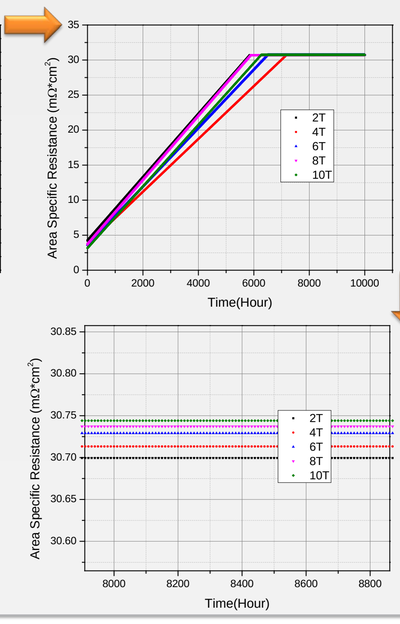
Calculated ASR



Electrical Resistivity X thickness = Area Specific Resistance







Acknowledgements

The U.S. Department of Energy's National Energy Technology Laboratory (NETL) funded the work summarized in this paper as part of the Solid-State Energy Conversion Alliance(SECA) Core Technology Program. Battelle Memorial Institute operates PNNL for the U.S. Department of Energy under Contract DE-AC06-76RLO1830.

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