Mn-Co electroplating on SS for SOFC interconnects

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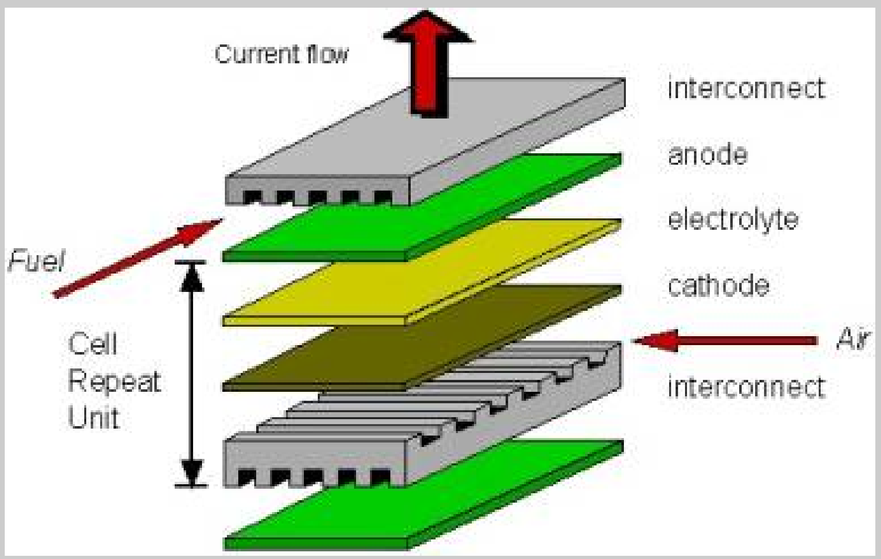
Objectives

To develop $(Mn,Co)_3O_4$ coating on ferritic stainless steel (FSS) by simple and cost effective methods;

To test the coating on FSS for Solid oxide fuel cells (SOFC)

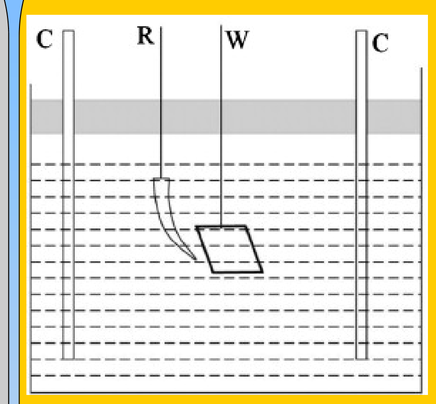
- Block Cr evaporation to the cathode;
- Mitigate scale growth



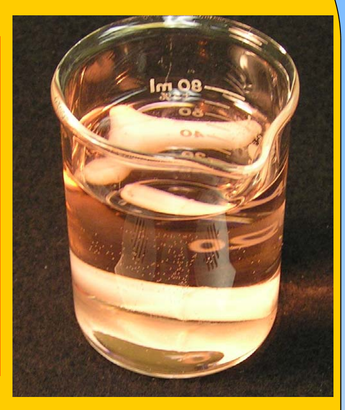
Strategies

- Deposit Mn-Co coating on FSS by electroplating—***cost effective***;
- Use nontoxic chemicals—***environmental friendly***;
- Oxidize the coating to form spinel—***simple process***;
- ASR and On-cell test—***performance evaluation***

Experimental setup



- FSS 430 as WE;
- Graphite as CE;
- SCE as RE;
- Direct current or pulse power supply



Thermodynamic calculations

Standard electrode potential:

- $Mn^{2+} + 2e \rightarrow Mn$ -1.18V
- $Co^{2+} + 2e \rightarrow Co$ -0.28V

To get the identical deposition potential

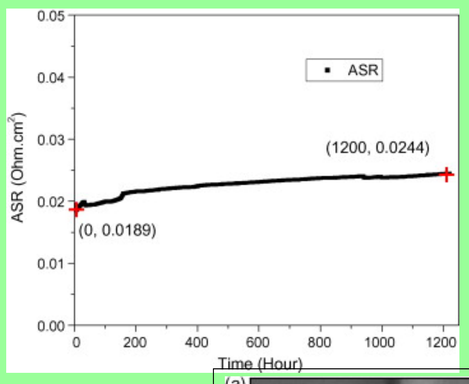
$$E^{\Theta}_{Mn^{2+}/Mn} = E^{\Theta}_{Co^{2+}/Co} - \frac{0.0591}{2}\log\frac{1}{a_{Co\,2+}}$$

$[Co^{2+}] = 10^{-31}$ mol L^{-1} for $[Mn^{2+}] = 1$mol L^{-1}

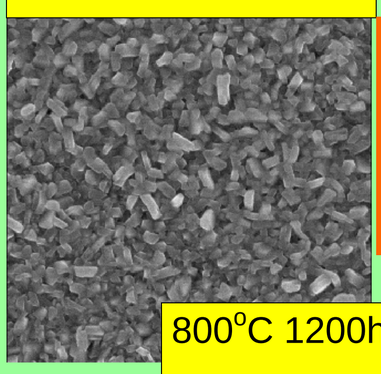
Additives were provided to solve the problem.

Area Specific Resistance (ASR) test

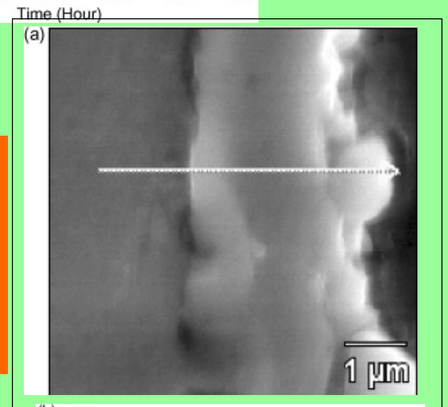
As-deposited



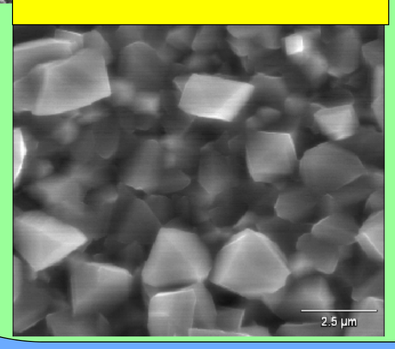
800°C 2hr

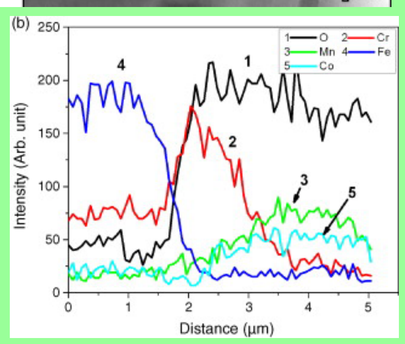


- *4-probe method;*
- *Stable ASR;*
- *No Cr diffusion to the coating*



800°C 1200hr





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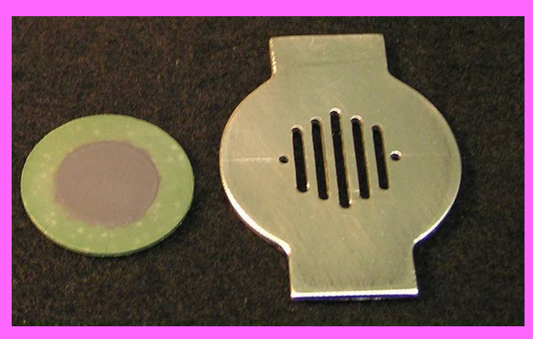
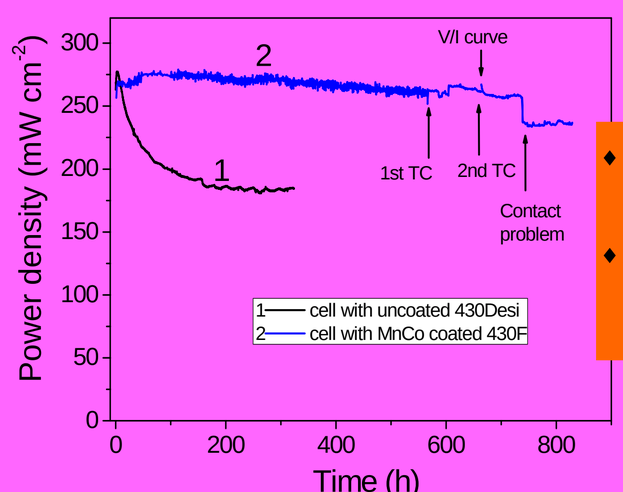
On-cell test

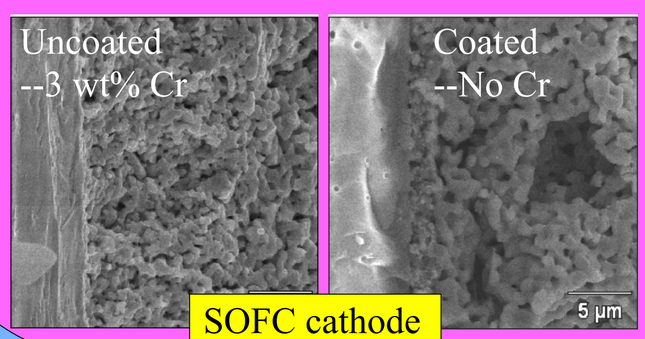


- Put coated interconnect on SOFC cathode as current collector;
- Bare 430SS for comparison;
- Two thermal cycles for coated interconnect



- Coated--relatively little degradation in 800h;
- Bare 430SS -- quick degradation in the initial 100h

No Cr poisoning was found in the cell with coated interconnect



J. Wu, et al., J. Power Sources 189 (2009) 1106–1113

Conclusions

- Mn-Co coating was deposited successfully by electroplating ;
- Both long term ASR and on-cell test prove that electroplated Mn-Co coating is promising for SOFC interconnect application.

Acknowledgements

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