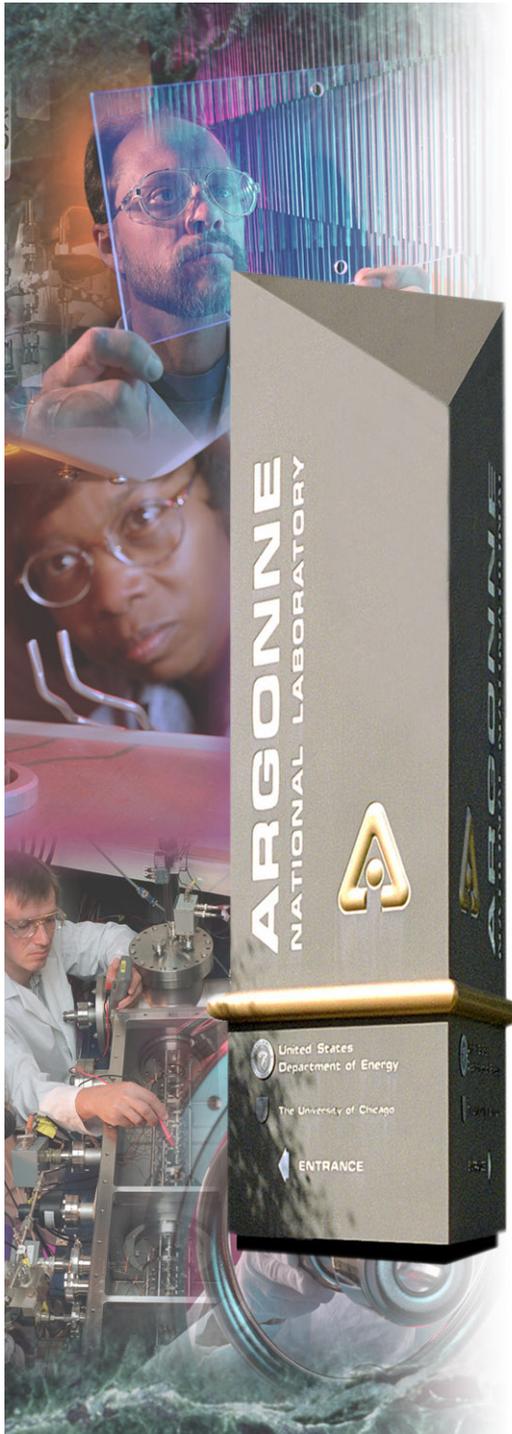


# ***Cathode / Interconnect Interactions***

Michael Krumpelt, Thomas Kaun,  
Terry A. Cruse, and Mark Hash

***SECA Annual Workshop  
May 11-13  
Boston, Massachusetts***

***Argonne National Laboratory***



A U.S. Department of Energy  
Office of Science Laboratory  
Operated by The University of Chicago



# ***The Chromium Issue***

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- **In cells with metallic bipolar plates, chromium accumulates in anodes and cathodes leading to cell failure**
- **In some cases, the problem appears to be worse at 700°C than at 800°C**



## Where could the chromium come from ?

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- 108.6



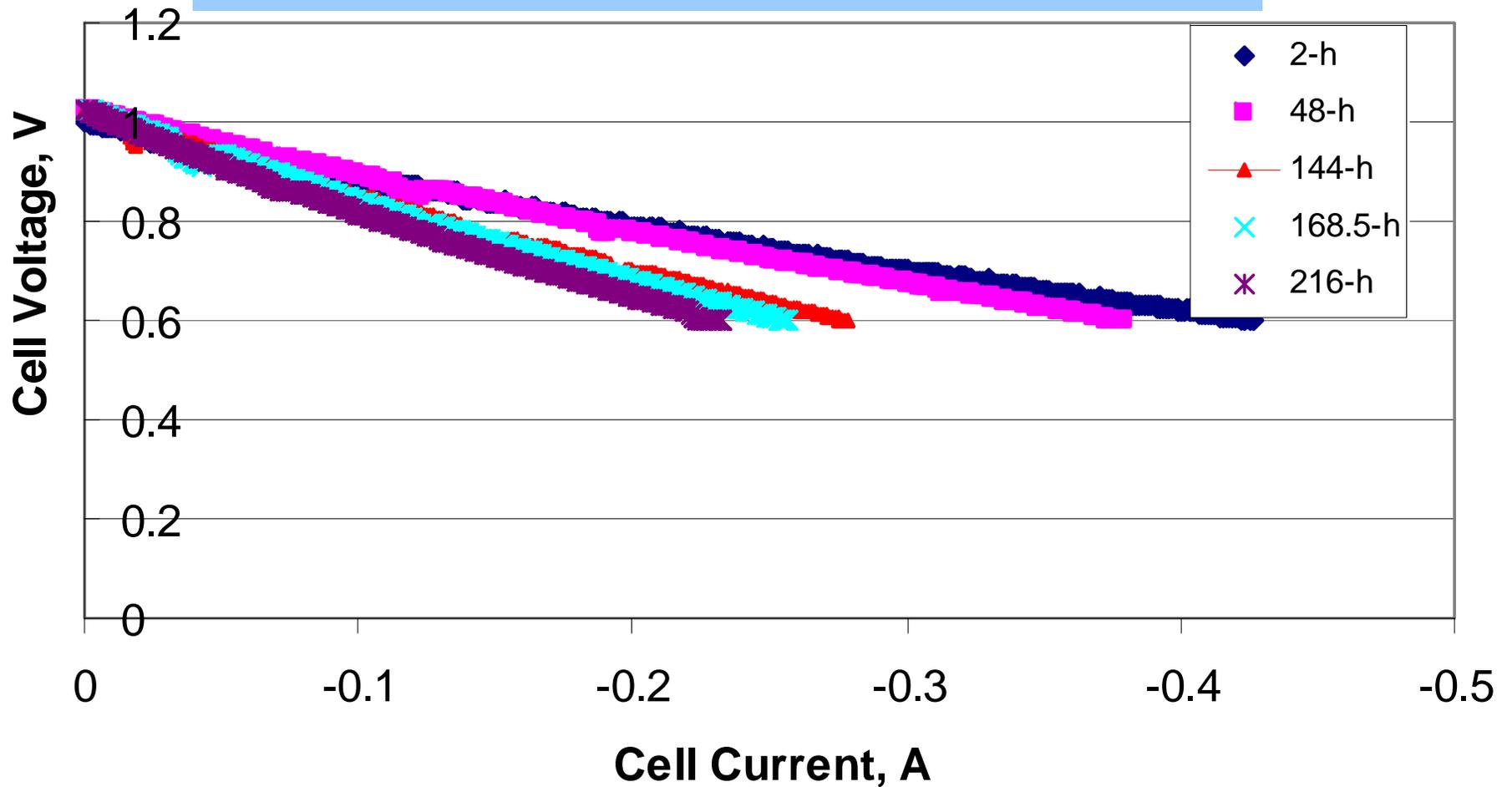
# Approach

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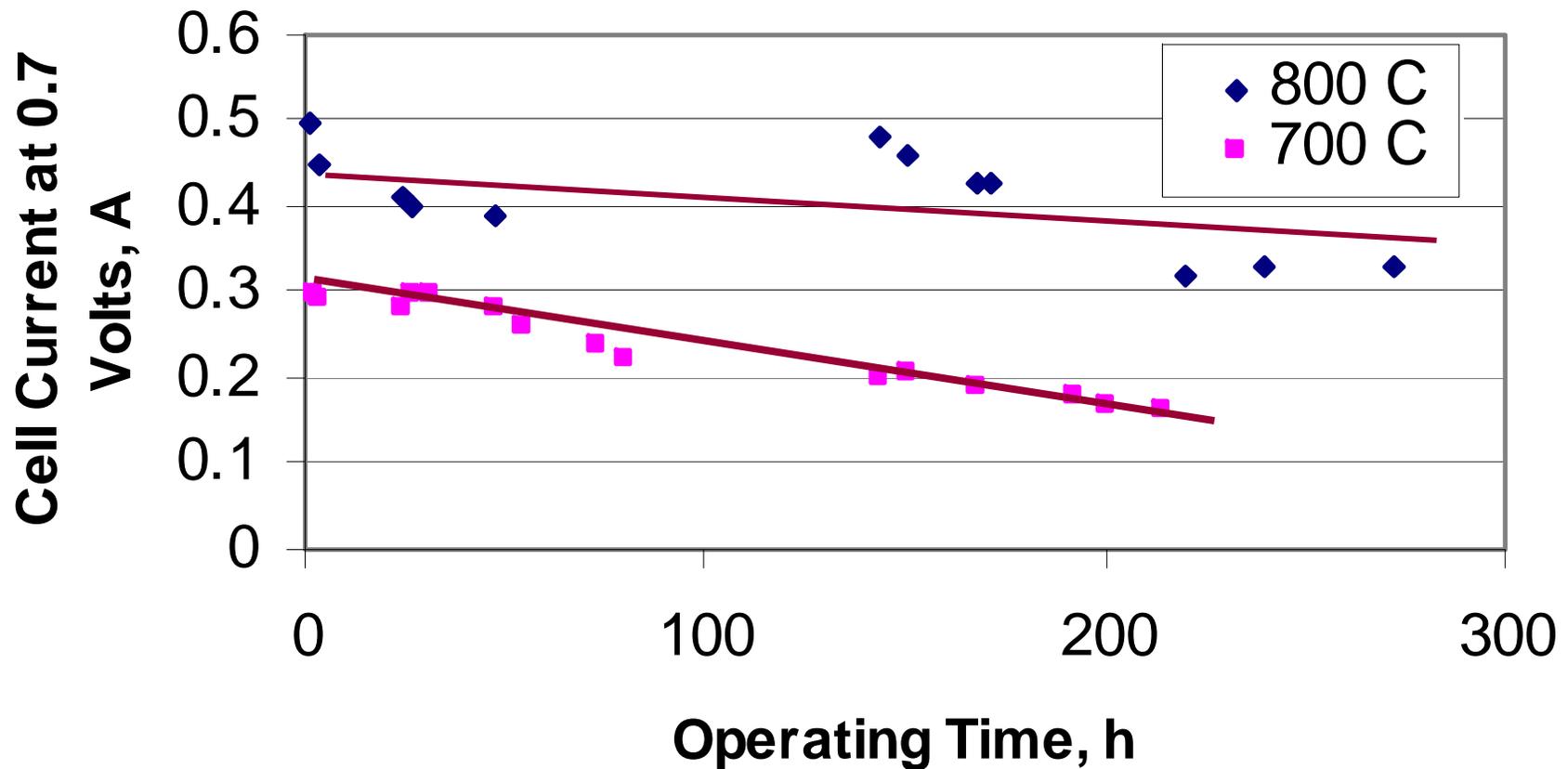
- **Operate cells at 700 and 800°C with SS430, E-Brite and Crofer interconnects**
- **Correlate chromium content in cathodes**
- **Equilibrate interconnect materials with cathodes and determine chromium content**
- **Measure weight loss of  $\text{Cr}_2\text{O}_3$**



SOFC #17 at 700 ° C exhibits ongoing performance decline,  
LSM with 430 SS and 2% Humidity

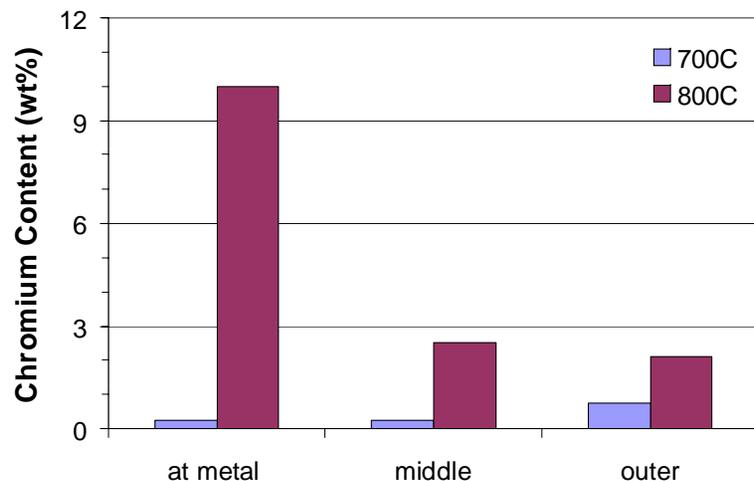


# SOFC Performance Stability at 800°C (#16) and 700°C (#17) having LSM cathode and 430 SS

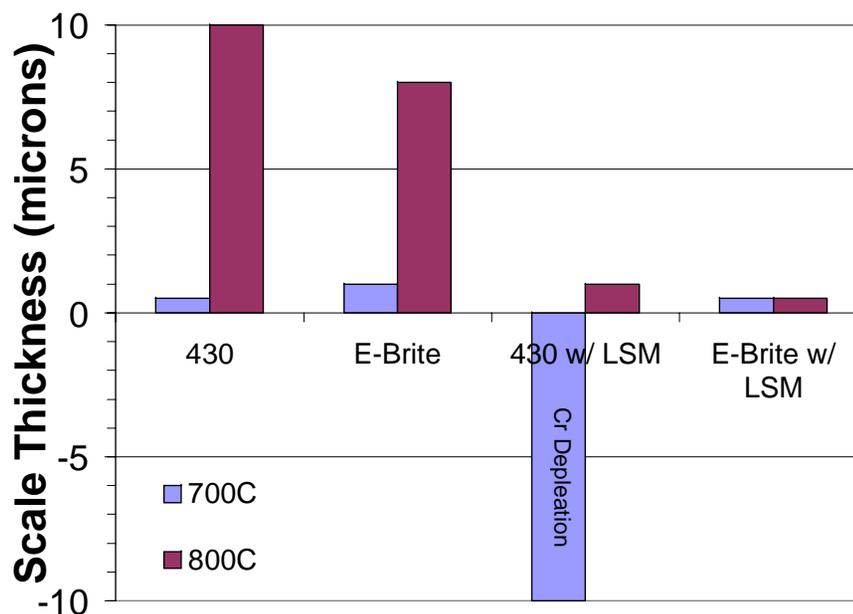
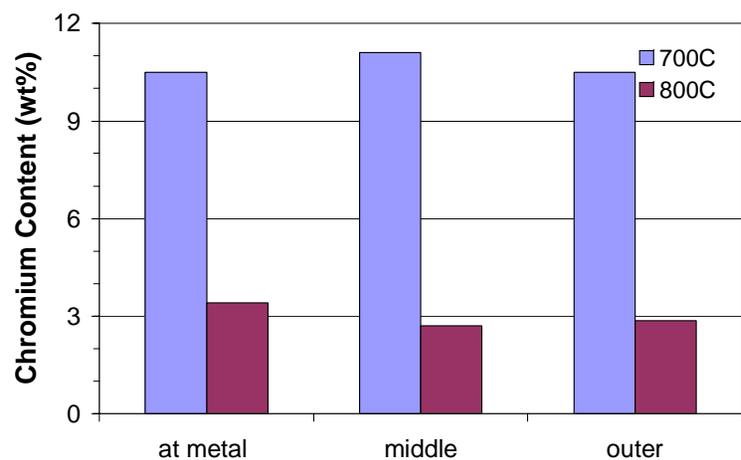


# Coupon Test Results in Air with 25% H<sub>2</sub>O

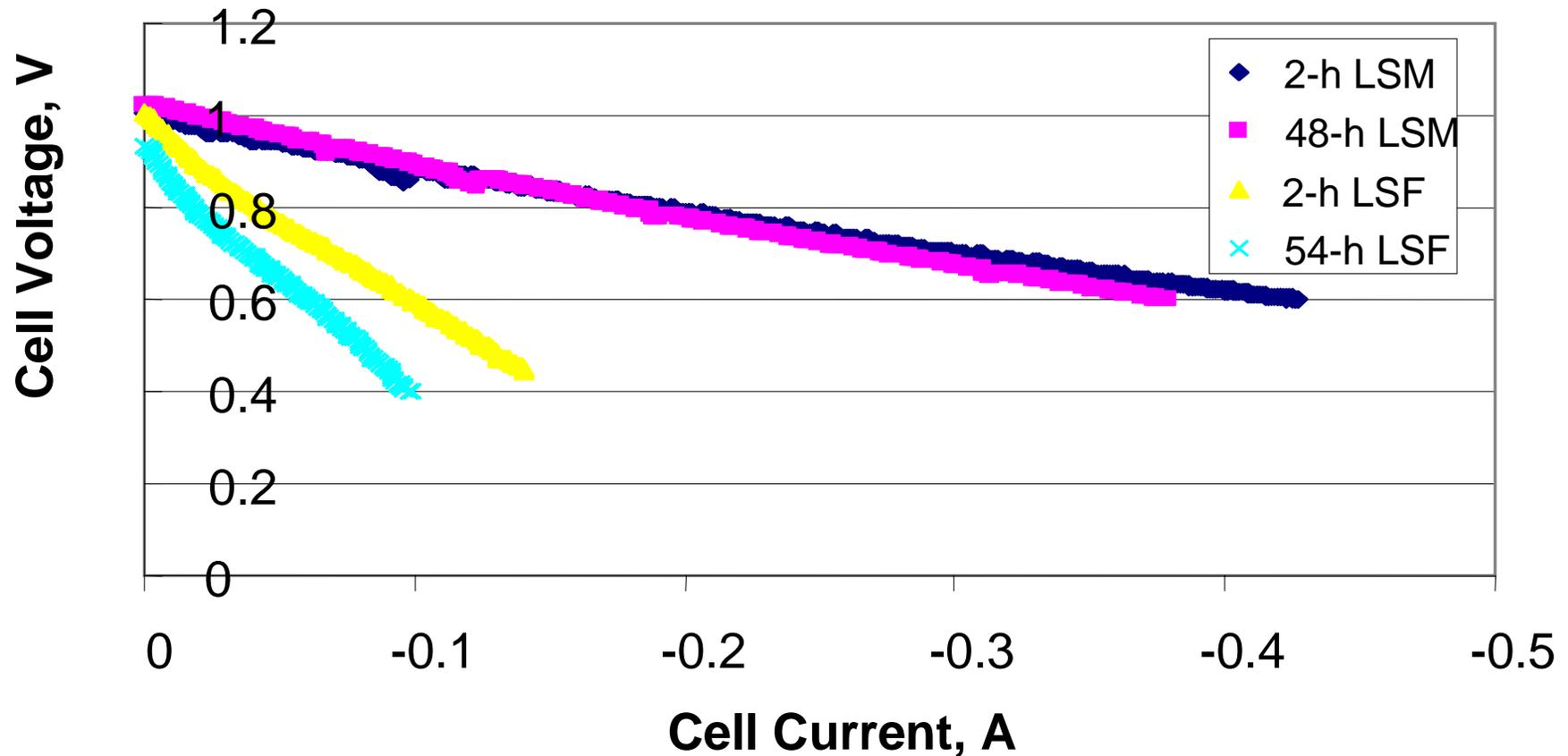
## LSM on 430 SS



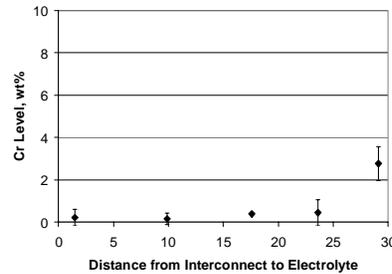
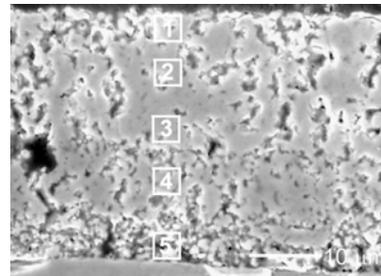
## LSM on E-Brite



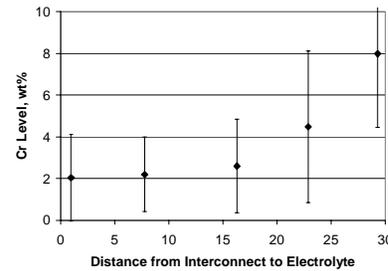
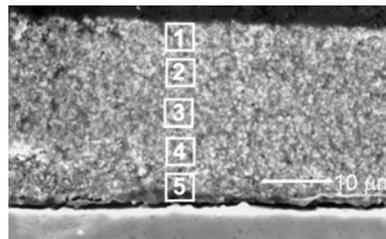
# Compare Polarization of SOFC at 700 C with LSM or LSF



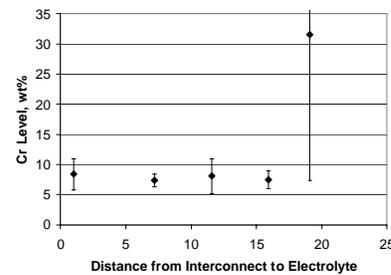
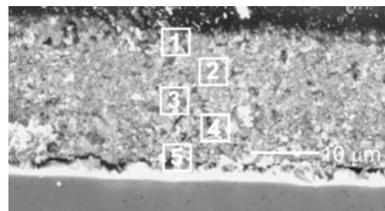
# Full Cell Testing with Crofer 22 APU Interconnect



**LSM**

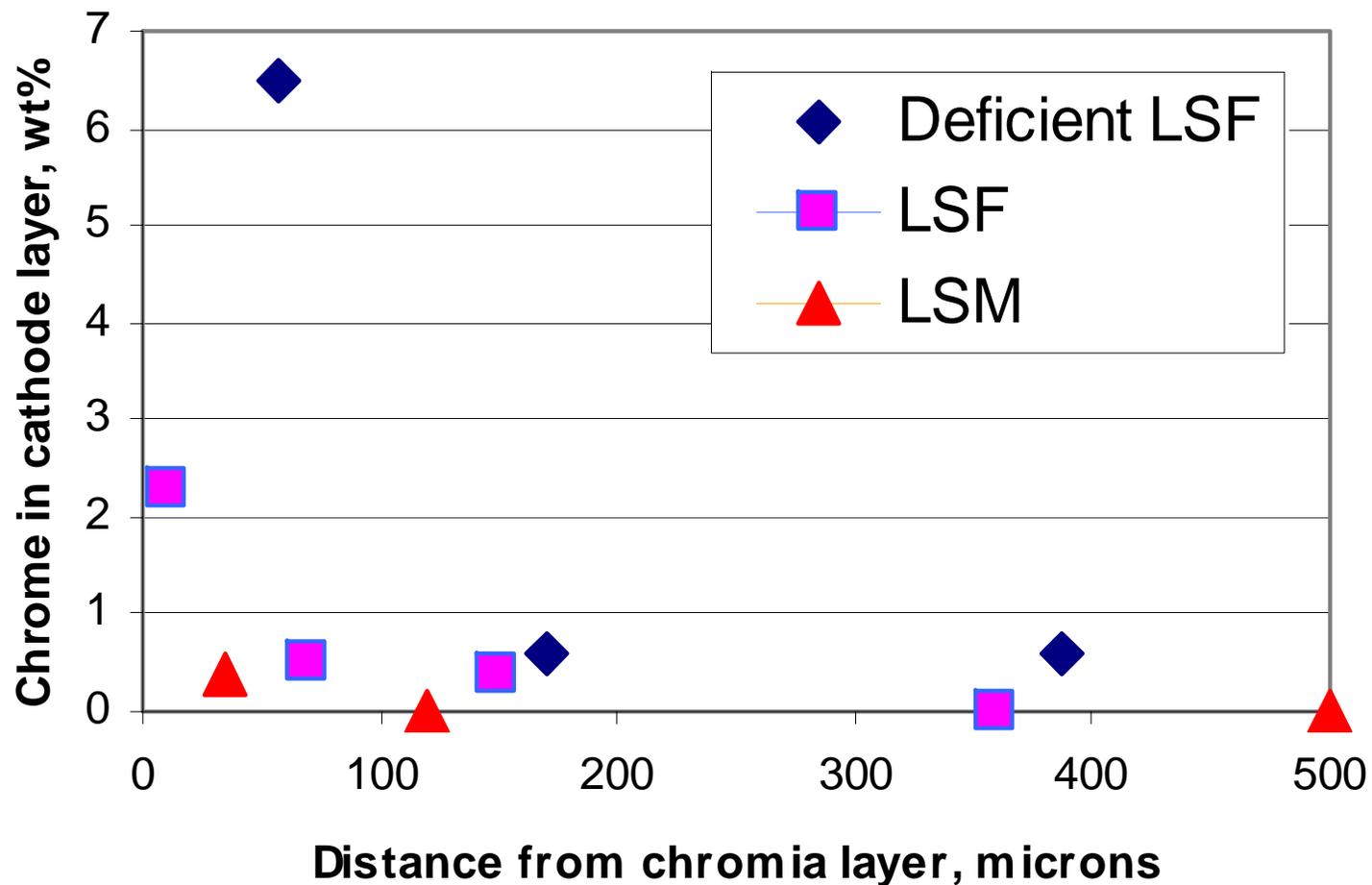


**LSF**

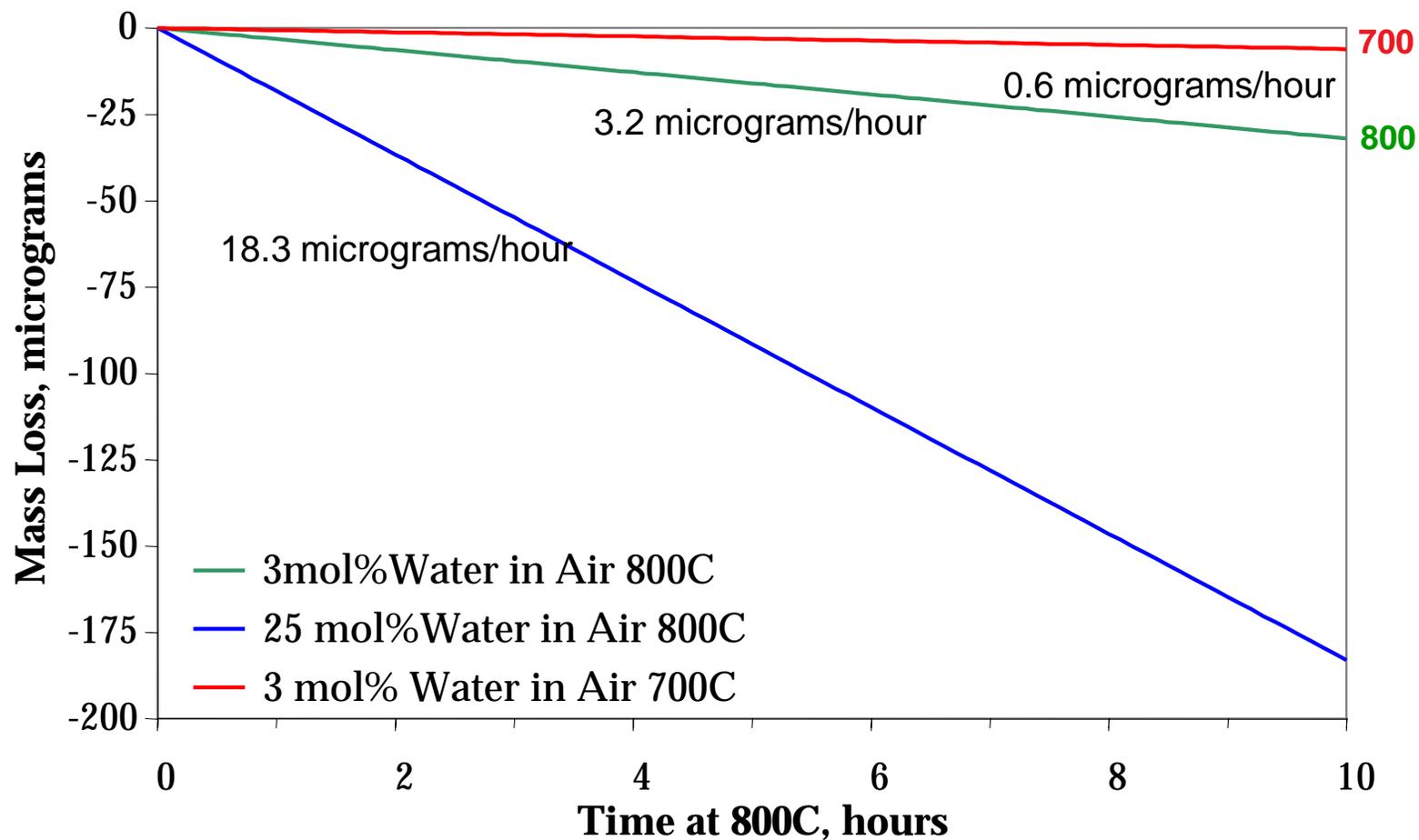


**Sub - LSF**

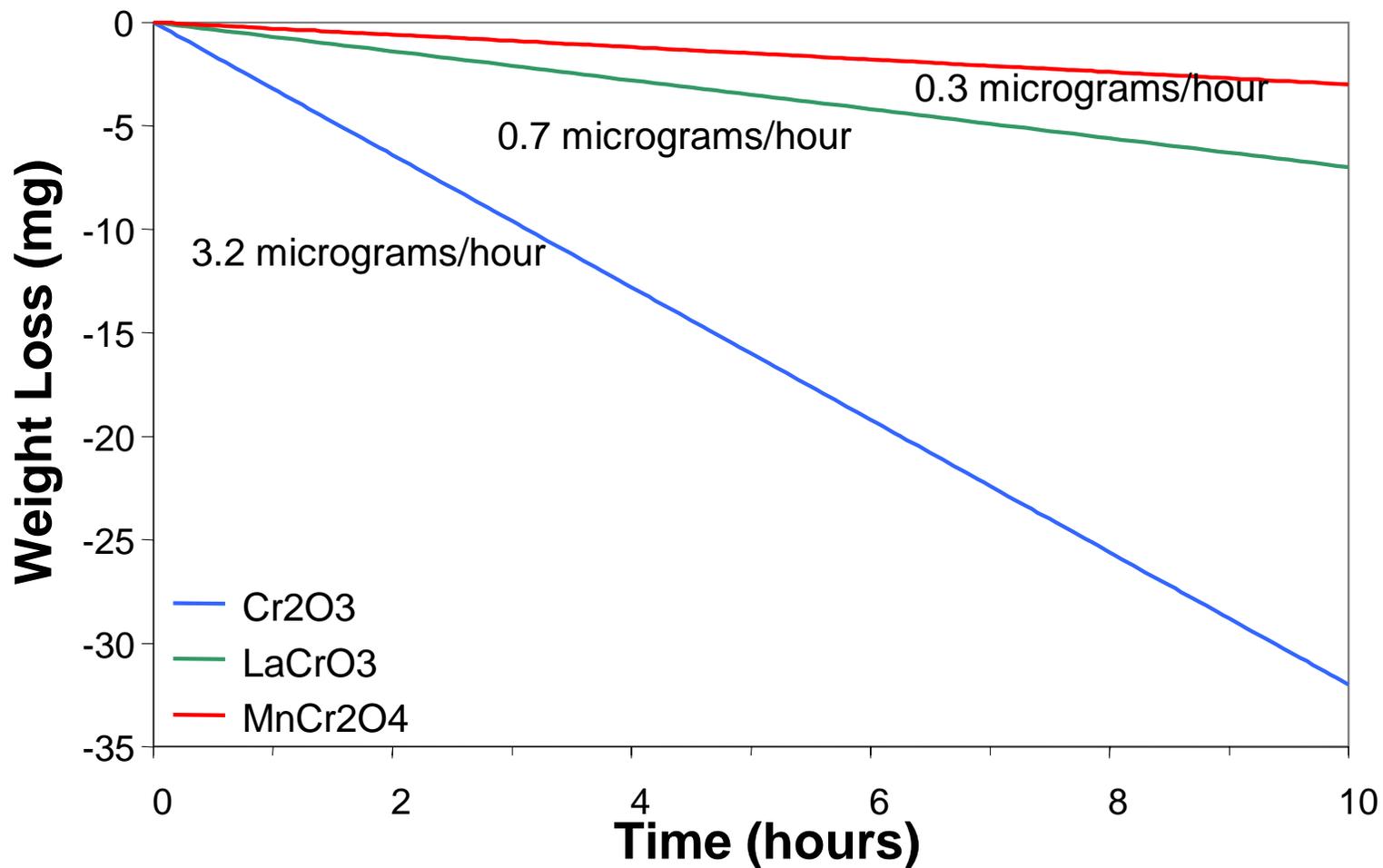
# Solid-State Reaction of Cathode Material with Chromia (Pressed-powder layers at 800°C)



# Mass Loss of Fine $\text{Cr}_2\text{O}_3$ Powder



# Air-3% Humidity, 800 °C



## Summary

- Evidence of Multiple Mechanisms of Cr Poisoning of the Cathode from Cell and Reaction Tests
- At 700°C the chromia scale is incomplete favoring a direct metal reaction, which is faster
- The Presence of H<sub>2</sub>O in the Cathode Gas Increases Cr Migration
- Cr Migration into LSF is Significantly Faster than into LSM
- Going to a Better Cathode, i.e. LSF<sub>sub</sub>, Poisoning Appears Faster
- Chromia Appears to React with Cathode Materials
- Chromium Content of Alloy Effects Poisoning



# ***Future Work***

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- **Continue analysis of Cr lose rates from different sources under different conditions.**
- **Examine cathodes with various amounts of Cr on the B-site.**
- **Improve sinterability of ceramic coating layers and consider additional materials, any materials containing Cr will need to be examined using TGA.**
- **Examine diffusion couples under different atmospheres.**

# Acknowledgements

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- Program Manager Lane Wilson

