Ceramic Anode-Supported Solid Oxide Fuel Cells with High Performance and Tolerances towards Carbon Deposition and Sulfur Poisoning

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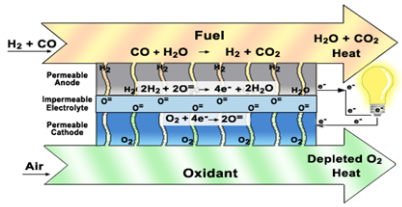
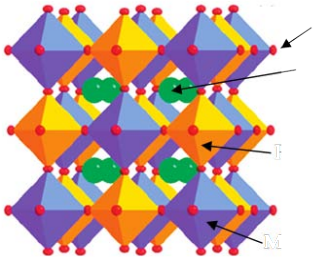


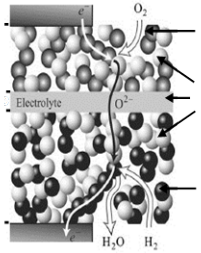
Fuel cell electrical efficiency, defined as: $\eta = \Delta G / \Delta H$	At 700°C			
Reforming by partial oxidation: $C_4H_{10}+2O_2=4CO+5H_2$	$\Delta H(kJ/mol)$	$\Delta G(kJ/mol)$	η(%)	# e
Direct oxidation: $C_4H_{10} + 6\frac{1}{2}O_2 = 4CO_2 + 5H_2O$	-2,660	-2,810	106	26
After reforming: $4CO + 5H_2 + 4\frac{1}{2}O_2 = 4CO_2 + 5H_2O$	-2,370	-1,760	74	18

Coking

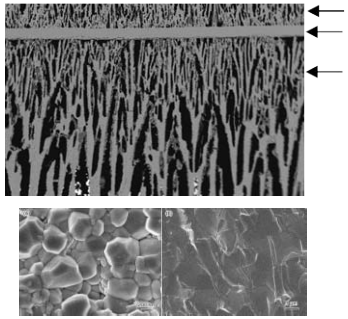
Sulfur poisoning



$Sr_2Fe_xMo_{2-x}O_{6-\delta}$ (SFMO)



$$J_L = -nF\, D_{H_2} \frac{\varepsilon}{\tau} \frac{C^*_{H_2} - C^0_{H_2}}{\delta}$$



Synthesis

- Solution based chemistry
- Freeze-tape casting
- Sintering aids

Modeling

- Multiphysics
- Structure – property
- Predicting and explanatory

Characterization

- Structure & microstructure
- Electrochemical performance
- *In situ* techniques

Collaborators:
China University of Mining & Technology, Beijing: M. Han—Freeze casting, sintering aids
University of South Carolina: K. Reifsnider & P. Majumdar—Multiphysics, 3D tomography
Oak Ridge National Laboratory: *In-situ* neutron diffraction
Brookhaven National Laboratory: X-ray absorption fine structure (XAFS)