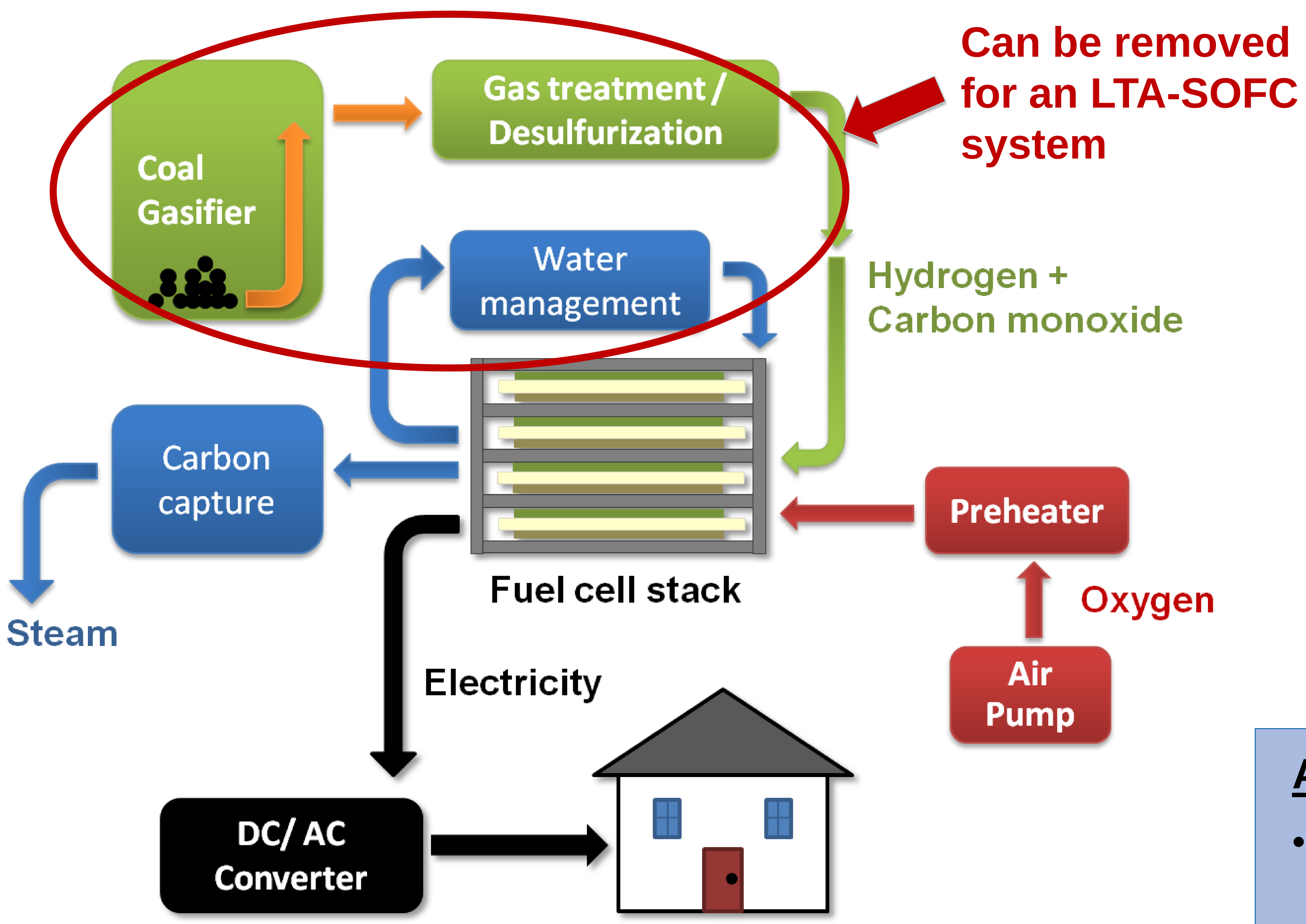
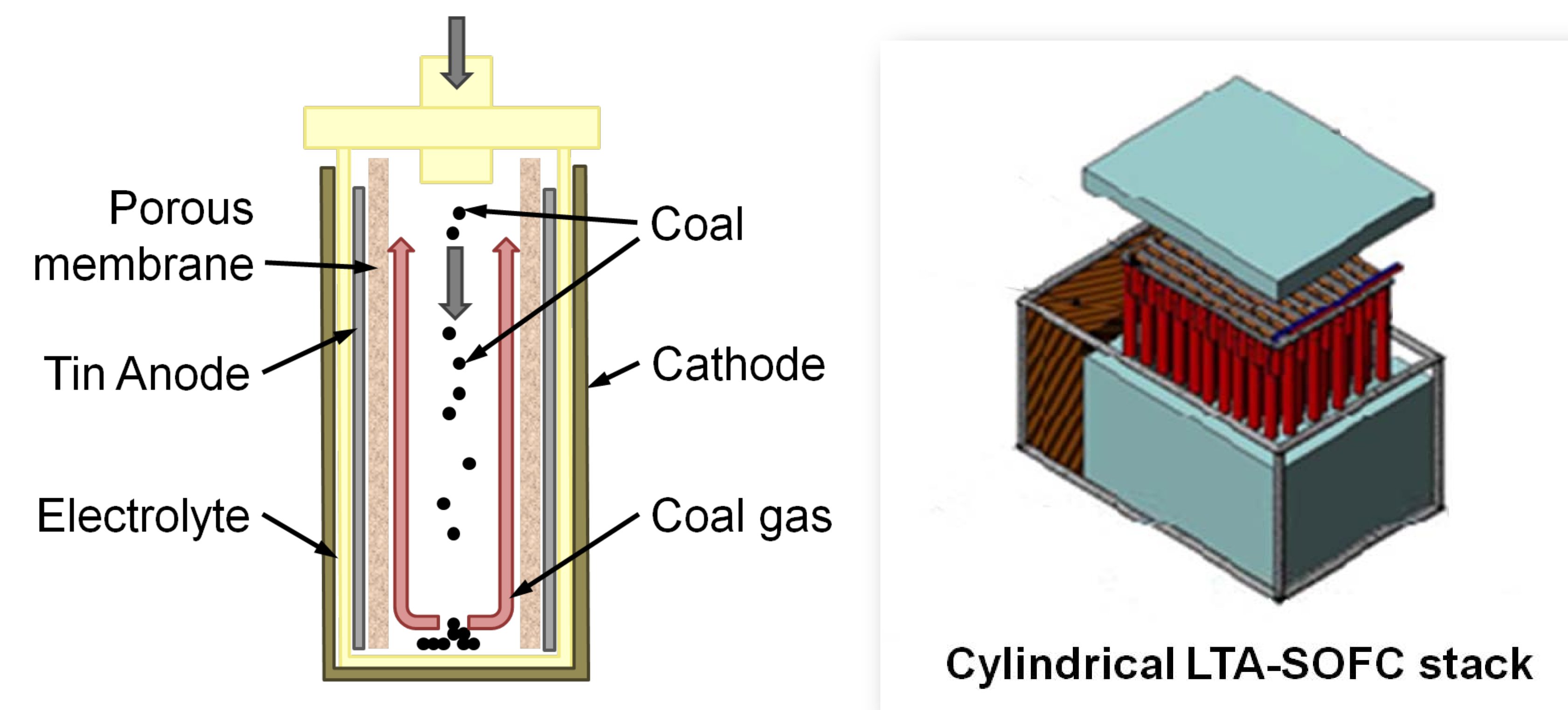
Direct Coal Solid Oxide Fuel Cells with Liquid Tin Anodes

the ENERGY lab
Website: www.netl.doe.gov
Customer Service: 1-800-553-7681

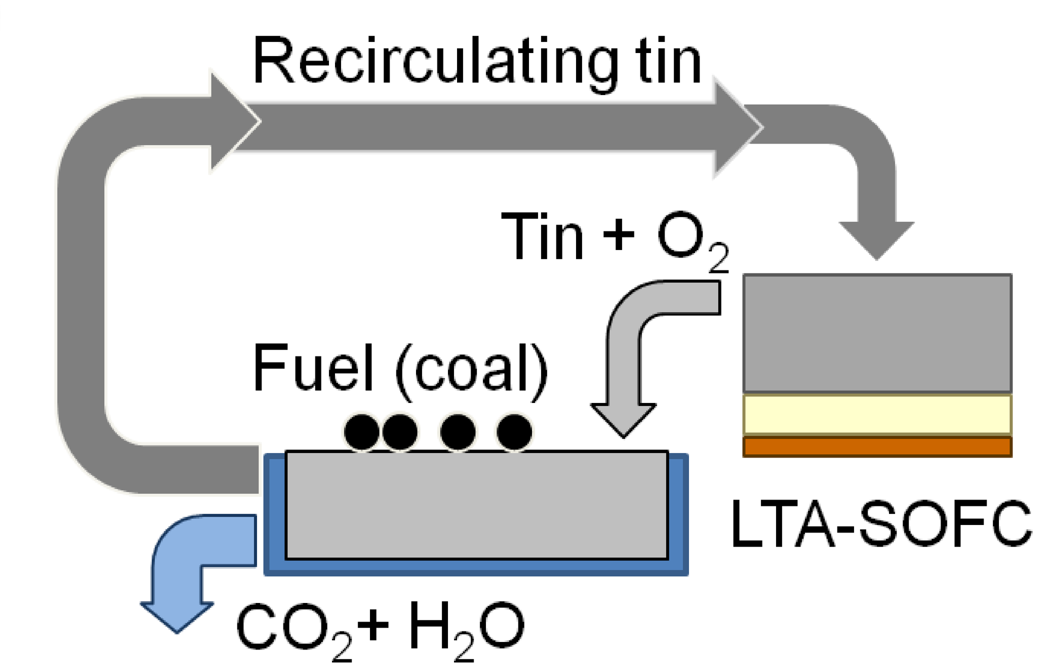
Running a fuel cell directly on solid coal, without the need for coal gasification



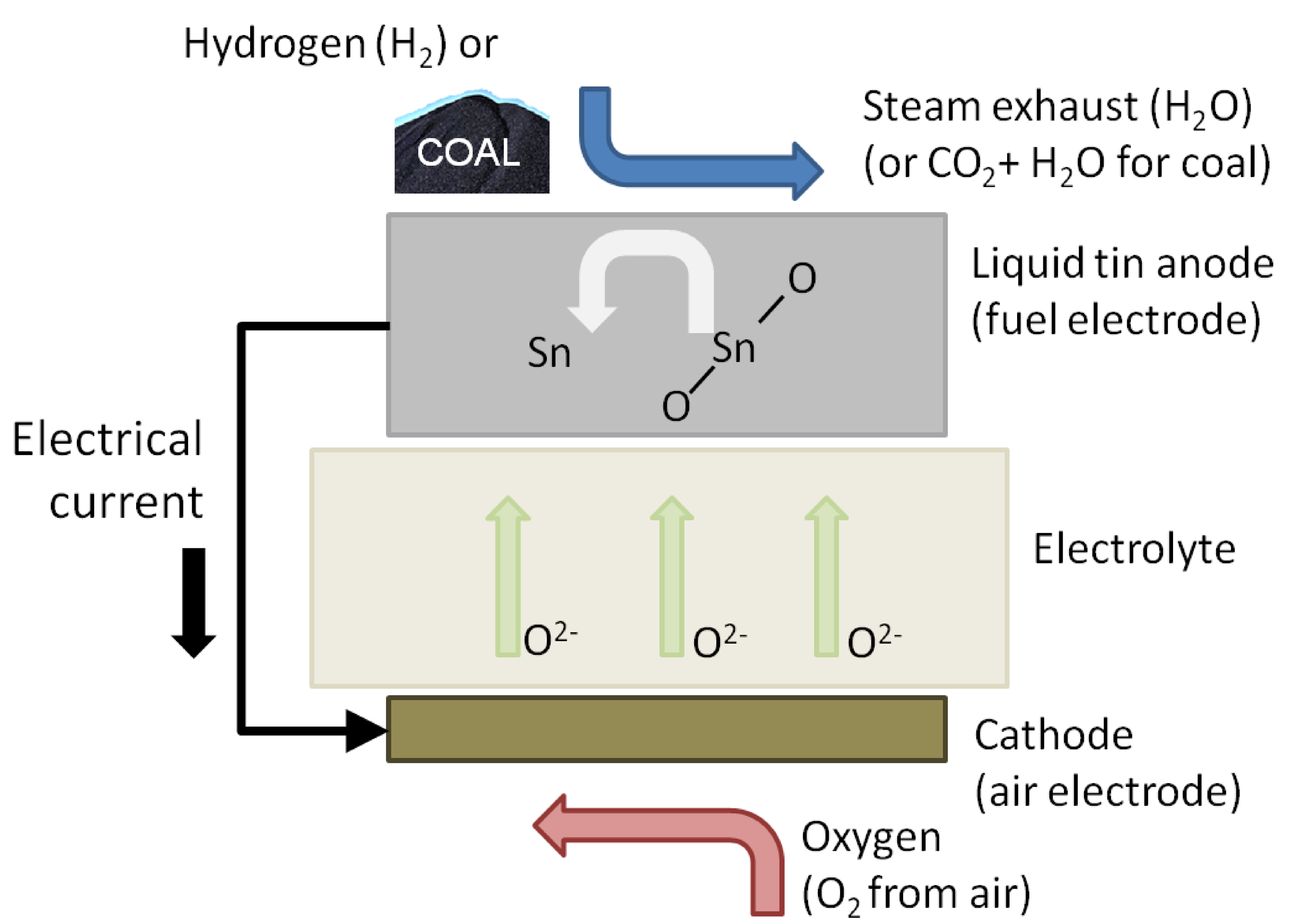
LTA-SOFC System Designs



Cylindrical Cell Design Developed by CellTech Power LLC
(Westborough, MA)



Planar Design in Which Tin Reacts with Fuel in Separate Chamber



A liquid tin anode solid oxide fuel cell (LTA-SOFC)

- **Operating Temperature: 800-1000ºC**
- **Highest Reported Power Density: 200 mW/cm²**

Advantages of an LTA-SOFC

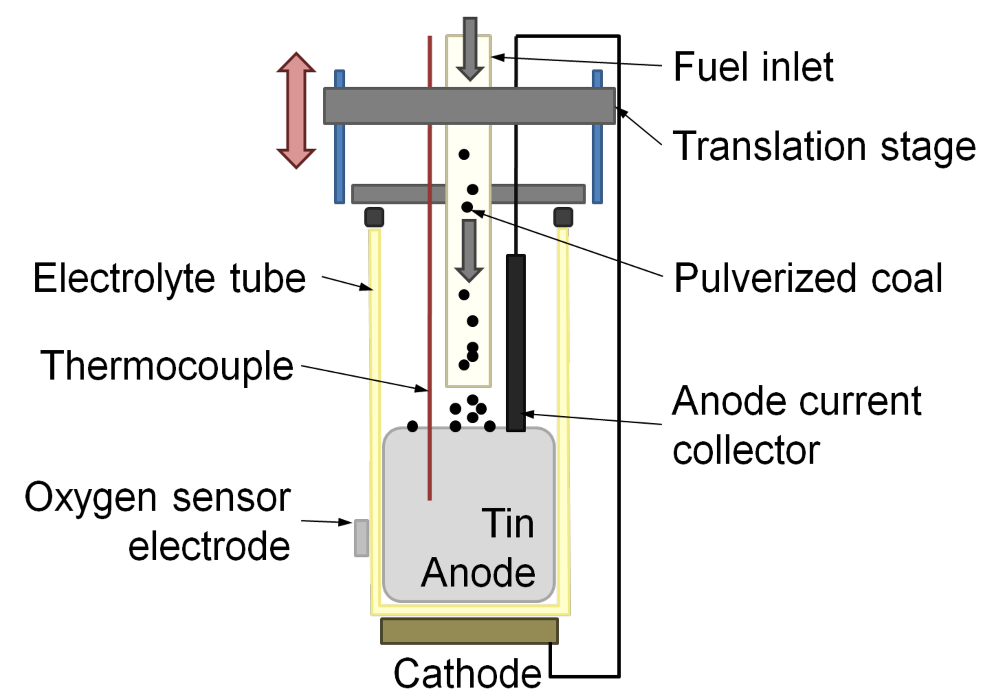
- **Extremely fuel flexible:**
  - Hydrogen, syngas, natural gas
  - Biodiesel, ethanol
  - Coal, JP-8, biomass, plastics
- **More tolerant to fuel contaminants**
- **Can run directly on liquid, solid fuels without gasification**
- **Can run for short periods in "battery mode", oxidizing the tin**

LTA-SOFC Research at NETL

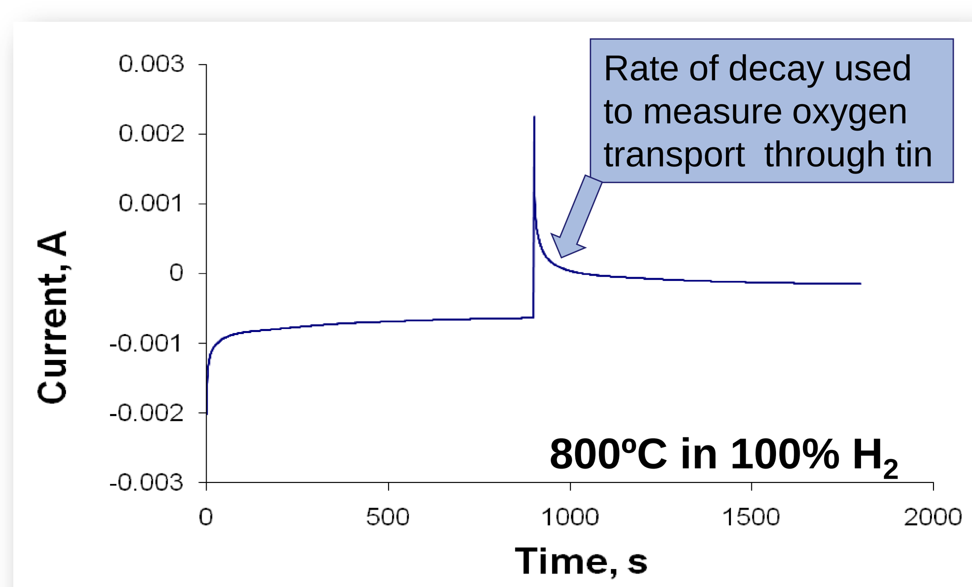
Objectives

- **Measure reaction rates of tin with different fuel sources**
- **Determine O_2, H_2 solubility limits of liquid metal anodes**
- **Determine performance limitations of liquid metal anodes**
- **Modify tin composition and design to improve performance**

Test Sample Installed in Furnace



Schematic of LTA-SOFC Test Sample



Current Response to 50 mV Step in Potential

Effective Oxygen Diffusion Coefficients in Pure Tin

Temperature, °C	Atmosphere	D_o, cm^2/sec
800	Nitrogen	2.91 x10^{-4}
800	Argon	7.49 x10^{-5}
900	Nitrogen	6.94 x10^{-4}
900	Hydrogen	1.05 x10^{-3}
900	Argon	1.04 x10^{-4}

Values in red from Chou, et al., *J. Electrochem. Soc.*, 142(6) 1995

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