Power Generation from Solid Fuels in a Solid Oxide Fuel Cell with a Molten Antimony Anode

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**Objective:** To enable facile oxygen transfer to solid carbonaceous fuel (i.e. coal, biomass) from an SOFC electrolyte using a molten antimony anode.

![Experimental Setup](image)

**Operating Temperature:** 973K

**Reactions involved**

3C + Sb\textsubscript{2}O\textsubscript{3} \rightarrow 2 Sb + 3 CO

2 Sb + 3 O\textsuperscript{2−} \rightarrow Sb\textsubscript{2}O\textsubscript{3} + 6e

O\textsuperscript{2−} + 4e \rightarrow 2 O

**Key Characteristic:** Sb (m.p. 903K) and Sb\textsubscript{2}O\textsubscript{3} (m.p. 929K) are both molten phases.

**Fuel Flexibility**

- **Temperature (°C):**
  - Sugar char
  - Rice starch
  - Carbon black
  - Graphite

**CO\textsubscript{2} formation (a.u.):**

TPR plots show that most forms of carbon reduce Sb\textsubscript{2}O\textsubscript{3} below the operating temperature of 973K.

**Performance on par with H\textsubscript{2}-SOFCs**

Sb anode with sugar char as fuel

**Very Low Anode Impedance**

![Nyquist Impedance Plot](image)

Ohmic and non-ohmic losses are those expected from ScSZ electrolyte and LSF-ScSZ cathode respectively.

► Sb Anode Impedance \(\approx 0\).

**Demonstration of Carbon Fuel Consumption**

Sb in C-fueled anode underwent two turnovers at a power density of 300 mW/cm\textsuperscript{2} before all the fuel was consumed. Without C fuel the anode performance falls due to Sb\textsubscript{2}O\textsubscript{3} accumulation.

Open Circuit Voltage = 0.75V for Sb/Sb\textsubscript{2}O\textsubscript{3} system.

Max. Power Density: 360 mW/cm\textsuperscript{2}

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