



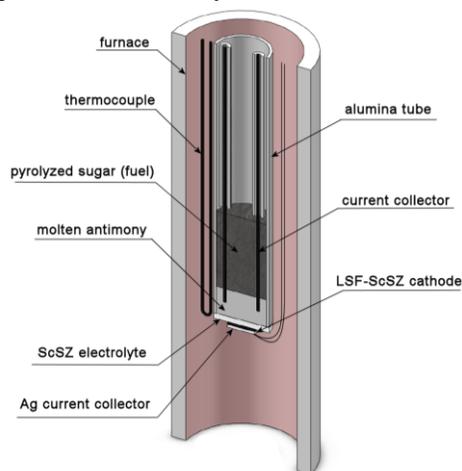
## A Direct Carbon Fuel Cell with a Molten Antimony Anode

*This research was conducted by the groups of Ray Gorte and John Vohs at the University of Pennsylvania and Doug Buttrey at the University of Delaware.*

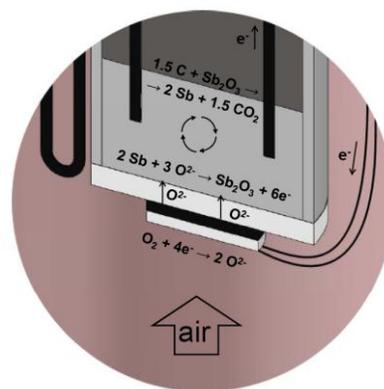
In order to secure our energy future, researchers have been working to develop technology capable of efficiently producing energy from cheap and abundant solid carbonaceous fuel resources, like coal and renewable biomass. Much research has been devoted to developing direct carbon fuel cells (DCFCs) to electrochemically convert solid carbonaceous fuels to electricity.

Researchers at the Universities of Pennsylvania and Delaware have further advanced DCFC technologies by generating electricity from solid carbonaceous fuels at high power densities while operating at intermediate temperatures. In a recent study<sup>[1]</sup>, CCEI researchers have demonstrated the direct utilization of carbonaceous fuels, including biomass, using a solid oxide fuel cell (SOFC) with a molten antimony (Sb) anode at 973 K. The anode operates by oxidation of metallic Sb at the electrolyte interface with the resulting  $\text{Sb}_2\text{O}_3$  being reduced by the fuel in a separate step. The reduction of  $\text{Sb}_2\text{O}_3$  is shown to occur readily by contact with a range of different carbonaceous fuels at the fuel cell operating temperature.

These DCFCs would be highly fuel flexible, tolerant to typical fuel impurities and could efficiently provide electricity from both coal and biomass while simultaneously allowing for easy  $\text{CO}_2$  capture.



Longitudinal section of the fuel cell system.



SOFC with molten Sb anode and solid carbonaceous fuel.

### RELEVANT PUBLICATION:

<sup>[1]</sup>Jayakumar, A.; Küngas, R.; Roy, S.; Javadekar, A.; Buttrey, D.J.; Vohs, J.M.; Gorte, R.J., “A direct carbon fuel cell with a molten antimony anode,” *Energy & Environmental Science*, (2011, Advance Article). [DOI: 10.1039/C1EE01863A]