Direct Electrochemical Oxidation of Coal in a Solid Oxide Fuel Cell

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The direct electrochemical oxidation of coal in a solid oxide fuel cell (coal-based fuel cell) is an innovative concept for power generation that could offer significant advantages: (i) minimization of NOx emissions due to its operating temperature range of 700 – 1000 °C, (ii) high overall efficiency, and (iii) production of a nearly pure (>99%) CO2 exhaust stream for the direct CO2 sequestration. Electrochemical oxidation of coal in a solid oxide fuel cell requires the use of anode catalysts that exhibit high oxidation activity and resistance to deactivation due to coal components. A fundamental understanding of the mechanism of the electrochemical oxidation of carbon in coal on the anode catalyst surface could provide the scientific basis for the development of such catalysts. This poster presentation will report results of an experimental study of the direct electrochemical oxidation of different types of carbonaceous solid fuels including coal, coke, pet coke, and biomass on a Ni/YSZ anode catalyst. The composition of the carbon fuel was correlated to the performance characteristics (the voltage – current polarization curves, V-I curves) and microstructure of the Ni/YSZ anode. Results from this study demonstrated the feasibility of the continuous electrochemical oxidation of carbon fuels containing low fly ash contents.