Direct coal solid oxide fuel cells with liquid tin anodes

U.S. Dept of Energy, National Energy Technology Laboratory, Morgantown, WV 26507
Harry Abernathy, Kirk Gerdes, Randy Gemmen
Phone: (304)285-4342, Kirk.Gerdes@NETL.DOE.GOV

Fuel cells are one of the most efficient methods for converting the chemical energy in coal directly to electrical energy, minimizing the amount of carbon dioxide and other pollutants produced per kilowatt of electricity even before scrubbing and carbon sequestration. To use coal as a fuel source, even the most tolerant solid ceramic fuel cell systems require prior gasification of the coal into syngas, which significantly adds to total system cost. By replacing the ceramic fuel electrode of a traditional high temperature solid oxide fuel cell (SOFC) with a liquid metal such as tin, pulverized coal or other solid fuels (such as waste plastics or biomass) can be supplied directly to the cell for electricity production. The lower overall performance of this novel system can be balanced by its reduced “balance of plant” costs.

Current research at the National Energy Technology Laboratory is directed at experimental and theoretical determination of the kinetic parameters of a liquid metal anode to evaluate the ultimate capabilities and limitations of an LMA-SOFC system. Oxygen transport through the liquid metal layer and the interfacial resistances between the anode and fuel is investigated, and the impact of LMA material selection and system design on these two performance parameters is investigated