

Project: High Temperature Electrochemistry Center (HiTEC)

Brief Description: MSU requests \$5 million for expansion of its research and education program in fuel cell related science and engineering with emphasis on materials issues, fuel impurity effects, and electrical power control.

Executive Summary: Fuel cells have tremendous potential for a wide variety of applications including auxiliary power, transportation power, and distributed generation. They show promise for high efficiency, low emissions and significant fuel flexibility (operation with natural gas, coal gas, propane, and biomass generated gas has been demonstrated). Issues remain for widespread market penetration for fuel cells that the High Temperature Electrochemistry Center (HiTEC) can address. HiTEC is a collaborative involving centers at Montana State University, and the Pacific Northwest National Laboratory.

Materials issues exist that can affect the longevity of fuel cells. Fuel cell stacks and electrical interconnects are in a high temperature, hostile environment. MSU has expertise in investigation of materials and interfacial phenomena that can help identify failure modes of fuel cell materials. Additionally, in collaboration with Montana private sector companies, MSU is developing and characterizing superior coating technologies with extremely low defects which should reduce failure rate of critical fuel cell components. Both MSU and PNNL are developing new materials for fuel cell cathodes, anodes and electrolytes as well as models to predict thermal properties and gas flow within the cells.

Relatively little work has been performed to address the response of fuel cells to abrupt changes in power load. MSU has expertise in distributed power generation and power monitoring and control will be used to investigate fuel cell response and to design control systems that will improve fuel cell performance for auxiliary and distributed power applications. Partnerships with the Montana private sector companies that are running fuel cell demonstration projects have been formed for this power monitoring and control project.

Congressional Action Needed: An appropriation of \$5 million is requested.

Importance to Montana: Montana has vast coal reserves a resource which can contribute to economic development in the state and energy security for the nation. The challenge is to utilize this resource in as efficient and environmentally and climate friendly fashion as possible. Fuel cells run on coal gas have the potential to be more efficient than conventional power plants and provide an inherent separation of CO<sub>2</sub> for potential sequestration. Work performed at MSU will help fuel cells realize that potential.

Contacts at MSU:

Thomas J. McCoy,	Vice President for Research	(406) 994-2891
Lee H. Spangler,	Director of Special Programs	(406) 994-4399

## HiTEC- High Temperature Electrochemistry Center – Talking Points

- Montana State is further developing freeze tape casting manufacturing techniques that show great promise for producing fuel cells with better fuel and air flow and potentially better thermal stability.
- MSU has a variety of techniques for investigation of impact of coal gas impurities on fuel cell performance.
- MSU has a strong materials research program and state-of-the-art characterization capabilities and experience in collaboration with the private sector. These capabilities will be used to explore materials performance and interfacial phenomena in fuel cell materials to gain insight into their failure mechanisms.
- MSU has developed a rapid method of measuring volatile species that may contribute to “poisoning” and degradation of fuel cells.
- Montana State is developing dynamic models that predict fuel cell response and that allow electrical engineers to design multi-source and distributed power systems that incorporate fuel cells.
- Montana State University is using ion beams and surface characterization techniques to investigate corrosion mechanisms in fuel cell interconnects.
- MSU has developed a fuel cell reference simulator that allows the power output of a small test cell to be scaled up. This allows development and testing of other components (such as power electronics) to occur before full size fuel cell stacks are built.
- In collaboration with Arcomac, a Montana company, we are developing and characterizing a superior coating technology. This technique is broadly applicable to many coating materials and provides extremely smooth, low defect, robust coatings that show promise in extending the life of critical fuel cell components.
- Montana State is developing brazed seals which have the potential to be much more durable than glass and ceramic seals currently used in fuel cell stacks.