Recent Developments in Material Science and Technology for Solid Oxide Fuel Cells

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ABSTRACT

Solid oxide fuel cells (SOFCs) are presently under development for a variety of power generation applications. The key features of the SOFC include all solid-state material construction and operation at high temperatures (800 to 1000C). Because all the components are solid, SOFCs can be fabricated in very thin layers, and cell components can be configured into unique shapes unachievable in liquid systems. This feature permits compact, lightweight cell designs with additional performance improvements. The high operating temperature allows internal reforming or direct oxidation of hydrocarbon fuels and makes the SOFC suitable for integration with a gas turbine to form highly efficient hybrid power generation systems.

In the past few years, several significant developments have taken place in the area of science and technology for SOFCs. These developments include (1) advances in the development of electrolytes for efficient operation at reduced temperatures (600 to 800C) (e.g., doped lanthanum gallates), (2) demonstration of various fabrication/processing techniques for making thin-film electrolytes, (3) engineering of doped lanthanum manganite cathode microstructures to demonstrate extraordinary performance (low polarization) at reduced temperatures, and (4) development of SOFC anodes for direct oxidation of hydrocarbon fuels.

This paper reviews recent developments in material science and engineering of the SOFC and discusses their impacts on the technology.