

High temperature fuel cells for clean and efficient power generation

Subhash C. Singhal

Pacific Northwest National Laboratory, USA

Solid oxide fuel cell (SOFC) is an electrochemical device which converts chemical energy of a fuel (such as hydrogen or a hydrocarbon) into electricity at temperatures from about 550 to 1000°C. SOFC offers certain advantages over lower temperature fuel cells, notably its ability to use CO as fuel rather than being poisoned by it, and high grade exhaust heat for combined heat and power, or for combined cycle gas turbine applications. Siemens successfully operated a 100 kW combined heat and power system for more than 36,000 hours with a voltage degradation of less than 0.1% per 1000 hours, and individual cells have been tested for over 8 years with ability to withstand over 100 thermal cycles. The most important need to commercialize this technology is to significantly reduce the overall cost of SOFC-based power systems. Reduction of operation temperature enables use of low-cost metallic interconnects and a decrease in maintenance costs. However, at lower temperatures, greater ohmic loss due to a reduction in ionic conductivity in the electrolyte and reduced catalytic activity of electrodes result in lower cell performance. To improve cell performance at lower temperatures, employing advanced materials with improved ionic conductivity for the electrolyte and mixed ionic-electronic conductivity for the electrodes has been investigated. This overview discusses the designs, materials and fabrication processes, and the performance of SOFCs under different operating conditions. Applications of such cells in stationary, mobile and military market sectors including their commercialization status are reviewed and challenges in reducing cell and system costs are summarized.

Biography

Singhal received his doctorate in Materials Science and Engineering from the University of Pennsylvania and an M.B.A. from the University of Pittsburgh. He has published 100 scientific papers, edited 17 books, received 13 patents and given over 320 plenary, keynote and other invited presentations worldwide. He joined Pacific Northwest National Laboratory (PNNL) in 2000 after having worked at Siemens Power Generation (formerly Westinghouse Electric Corporation) for over 29 years. At PNNL, he provided senior technical, managerial, and commercialization leadership to the Laboratory's extensive fuel cell and clean energy programs. At Siemens/Westinghouse, he was manager of Fuel Cell Technology. Dr. Singhal is a member of the U. S. National Academy of Engineering and the Washington State Academy of Sciences, and a Fellow of four professional societies.

Subhash.Singhal@pnnl.gov