NWS05-2005-000032

Abstract for an Invited Paper
for the NWS05 Meeting of
the American Physical Society

Improving the Performance and Durability of Solid Oxide Fuel Cells

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Fuel cells are highly efficient devices that cleanly and quietly convert chemical energy into electricity. Indeed, certain types of fuel cells have theoretical fuel-to-electricity conversion efficiencies close to 100% and have realizable efficiencies approaching 50%. There are a number of types of fuel cells that are currently in various stages of development, but it is generally accepted that proton exchange membrane fuel cells (PEMFCs) and solid oxide fuel cells (SOFCs) offer the most promise of flexibility of application, fuel options, and the potential to realize high fuel conversion efficiencies. However, PEMFCs are hindered by their need for ultra-high purity (<50 ppm CO) H_2, while SOFCs can operate on CO/H_2-based reformates. As a consequence, SOFCs are ideally suited for less costly, readily accessible fuel supplies. However, the SOFC anode performance can be compromised by such factors as exposure to certain sulfur-containing fuels and the deposition of coke when using hydrocarbon fuels. In terms of the cathode, its performance is limited primarily by the slow kinetics of the oxygen reduction reaction, while its lifetime can be negatively affected by factors related to the corrosion of currently used stainless steel interconnect materials. This talk will present an overview of these challenges and some possible solutions to these problems. This presentation will also explain how electrochemical methods can be used to evaluate and improve the performance of SOFC anodes, cathodes, and interconnect materials.