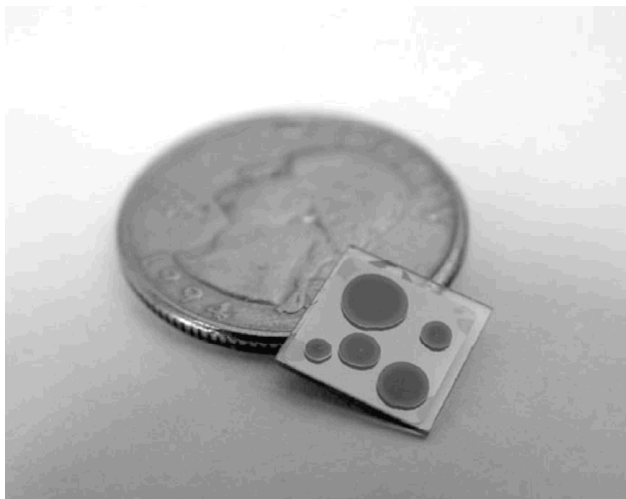


Microfabricated Thin-film Electrolytes and Electrodes for Solid Oxide Fuel Cells

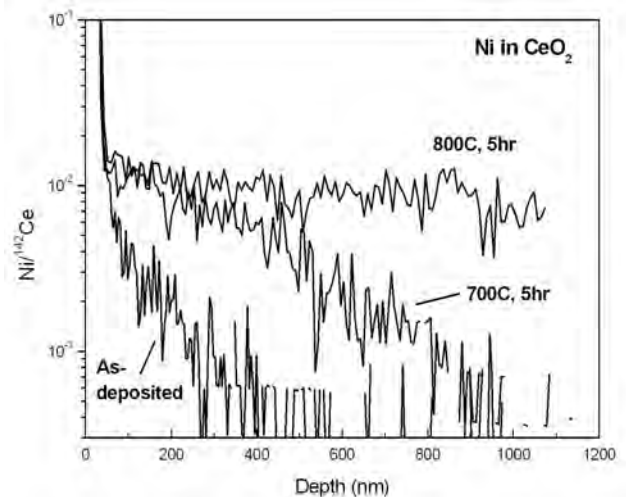
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There is growing interest in the microfabrication of electrodes for solid oxide fuel cells (SOFCs) in microionic devices [1]. Recently, we reported the fabrication of Pt/(Zr,Y)O₂ (YSZ) nanocomposite electrodes by reactive magnetron co-sputtering [2]. Use of X-ray diffraction and X-ray photoelectron spectroscopy (XPS) characterization show these composites to be a two-phase system with no change of oxidation state from the constituent compounds. Electrical characterization via impedance spectroscopy demonstrated promising electrochemical properties at low temperatures; an area-specific resistance of 500 Ω cm² was achieved at 400°C. To test whether microfabricated thin-film electrolytes may suffer from degradation due to grain boundaries acting as short-circuit-

ing diffusion pathways, sputtered NiO diffusion source films were in-diffused along grain boundaries into nanocrystalline CeO₂ thin films grown by pulsed laser deposition (PLD), at temperatures from 700-800°C. The diffusion profiles were measured by Time-of-Flight Secondary Ion Mass Spectrometry (ToF-SIMS) at the Institute for Physical Chemistry at RWTH Aachen University, Germany. These SIMS spectra, shown in Figure 2, point to a single diffusion mechanism, believed to be grain boundary diffusion, at these relatively low temperatures. Further work to systematically determine the unique opportunities and challenges associated with microstructured SOFCs is currently underway.



▲ Figure 1: Photograph of a Pt/YSZ composite microelectrode device fabricated by reactive magnetron sputtering. Five microelectrodes lie on the surface and the counter electrode is visible through the transparent YSZ substrate².



▲ Figure 2: The ToF-SIMS spectra of Ni diffusion in CeO₂. The as-deposited profile is shown, as are profiles resulting from anneals at 700 and 800°C for 5 hours. In the 800°C sample, Ni has diffused through the entire film.

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