

# Micro-fuel cell summary

- **Micro-fabrication with *nano* technology**
  - a MEMS-based approach using photolithography and micromachining processes
  - materials selection options for fuel flexibility
  - demonstrated fuel cell module for PEM and SOFC
  - integration of fuel processing with fuel cell module
    - catalyst selection for minimal loading and contamination
    - high conversion efficiency and low CO generation
    - use of 2-D and 3-D nanoporous films for electrodes
  - universal platform for integration into device microelectronics

# United States Patents

- Bonded Polyimide Fuel Cell Package and Method Thereof,
  - U.S. Patent 6,960,403 (1 November 2005)
- Chemical Microreactor and Method Thereof,
  - U.S. Patent 6,960,235 (1 November 2005)
- Microfluidic Fuel Cell Systems with Embedded Materials & Structures and Process Thereof,
  - U.S. Patent No. 6,921,603 B2 (26 July 26 2005)
- Vapor-Deposited Porous Films for Energy Conversion,
  - U.S. Patent No. 6,913,998 (5 July 2005)
- Method of Forming a Package for MEMS-Based Fuel Cell,
  - U.S. Patent 6,821,666 B2 (23 November 2004)
- Method for Fabrication of Porous Thin Film Electrodes for Fuel Cell Stacks,
  - U.S. Patent No. 6,753,036 (22 June 2004)
- Method for Fabrication of Electrodes and Electrolytes,
  - U.S. Patent No. 6,673,130 B2 (6 January 2004)
- MEMS-Based Solid-Oxide Fuel Cells,
  - U.S. Patent No. 6,638,654 (28 October 2003)
- Hybrid Deposition of Thin-Film Solid-Oxide Fuel Cells and Electrolyzers,
  - U.S. Patent No. 6,007,683 (28 December 1999)
  - U.S. Patent No. 5,753,385 (19 May 1998)

# Journal and Conference Publications

- Characterization of Vapor Deposited Nano Structured Membranes,
  - *Nanostructured Materials in Alternative Energy Devices* MRS Proc. 822 (2004) 97-102
- Sputter Deposition of Metallic Sponges,
  - *J Vac Sci Technol A* 21 (2003) 422-425
- Micro-Fabricated Thin-Film Fuel Cells for Portable Power Requirements,
  - *Materials for Energy Storage, Generation and Transport*, MRS Proc. 730 (2002) 93-98
- Porous Thin-Film Anode Materials for Solid-Oxide Fuel Cells,
  - *New Materials for Batteries and Fuel Cells*, MRS Proc. 575 (2000) 321-324
- A Novel Proton Exchange Membrane Thin-Film Fuel Cell for Micro-Scale Energy Conversion,
  - *J Vac Sci Technol A* 18 (2000) 2003-5
- Testing of Thin-Film SOFCs for Micro to Macro Power Generation,
  - *Solid Oxide Fuel Cells VI*, ECS Proc. 99-19 (1999) 932-937
- A Novel Thin-Film Solid-Oxide Fuel Cell for Micro-scale Energy Conversion,
  - *Micro-machined devices and Components V*, SPIE Proc. 3876 (1999) 223-225
- Thin Film Synthesis of Novel Electrode Materials for Solid-Oxide Fuel Cells,
  - *Materials for Electrochemical Energy Storage and Conversion II*, MRS Proc. 496 (1998) 155-158
- Thin-Film Solid-Oxide Fuel Cells,
  - *Ionic and Mixed Conducting Ceramics III*, ECS Proc. 97-24 (1998) 106-113