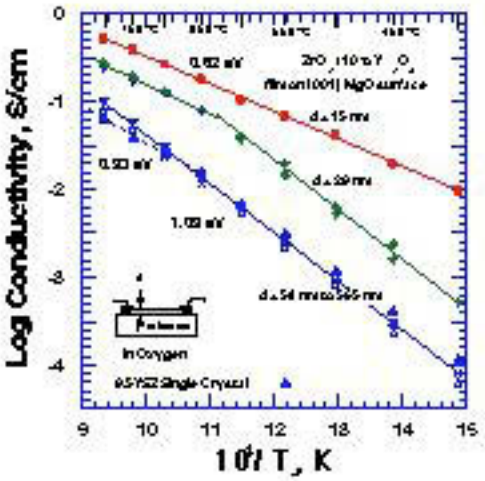
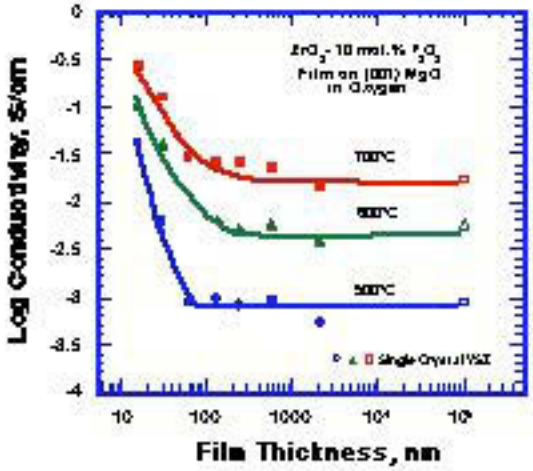
Observation of *Superionic* Conductivity in Highly Oriented *Nanometer Scale* ZrO_2-10 mol% Y_2O_3 (10YSZ) Films

Nanometer Scale, Oriented 10YSZ Films Become *Superionic* Conductors as the Film Thickness Decreases.

- 16-nm thick 10YSZ film exhibits *highest ionic conductivity ever reported.*
- ~ 200-fold greater than that of conventional ZrO_2 electrolyte ceramics at 400°C!
- Conductivity of film at 550°C equals that of YSZ ceramics at 900°C!



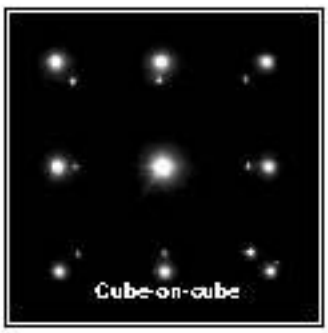
Nanostructured Films are the Model for the Next Generation of Solid Oxide Fuel Cell (SOFC) Electrolytes



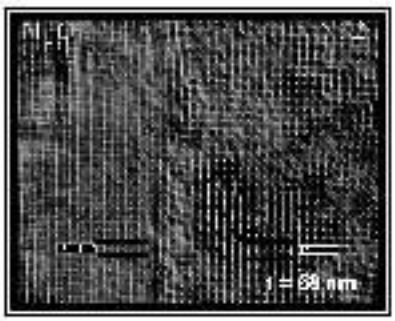
Important scientific implications:
Ionic conductivity dominated by interfacial and surface conduction (σ_{is}) as compared to bulk (σ_b) mechanisms, which can be uniquely assessed due to the film characteristics.

Technological implications:
Thickness-dependent interfacial and surface effects suggest potential nanostructured and superlattice effects for variety of applications.

Exceptional Quality of Pulsed Laser Deposited Oriented 10YSZ Films on (001)MgO



- Cube-on-Cube Orientation and Absence of Dislocation Arrays
- Optimized Y_2O_3 Content to Enhance Conductivity
  - Ionic conductivity maximized at 9 to 10 mol % Y_2O_3
  - EDS analysis confirms film contains 9.6 mol % Y_2O_3
- In-plane strain as a_o of YSZ is ~ 20% larger than a_o of MgO



L. Kosacki, P. F. Becher – Structural Ceramics Group, Metals and Ceramics Division
C. M. Rouleau and D. H. Lowndes – Thin Film and Nanostructured Materials Physics Group, Solid State Division
J. Bentley – Microstructural Analysis Group, Metals and Ceramics Division
Oak Ridge National Laboratory

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