Design of Superplastic Ceramics

Fine grain superplastic microstructures allow net-shape forming at high temperatures yet still maintains high strength at room temperature.

Challenge: Design Multi-component Microstructures to Limit Grain Growth but Promote Grain Boundary Sliding

\[ \dot{\varepsilon}_0 = 1.0 \times 10^4 \text{s}^{-1} \quad \sim 520\% \]

\[ \dot{\varepsilon}_0 = 1.0 \times 10^{-3} \text{s}^{-1} \quad \sim 190\% \]

NSF Grant DMR - 0606063

Mecartney Group Research
Electron backscattered diffraction on a field emission scanning electron microscope is used to determine the relative orientation of grains in mullite. The color coded images show that the long axis of acicular grains is the c-axis [001], and the sides of the grains are [100], [010] or [110]. This information on how crystals are aligned helps explain the creep resistance of the material at high temperatures.
AFM Metrology and Nanoparticles

Navy Contract N00244-05-P-2456

Mecartney Group Research
Solid Oxide Fuel Cell (SOFC) Electrolytes

What role does the chemistry and structure of grain boundaries play in controlling ionic conductivity?

Lanthanum apatite ceramics

Nanocrystalline Y-CSZ on Si