

HIGH PERFORMANCE DIELECTRICS

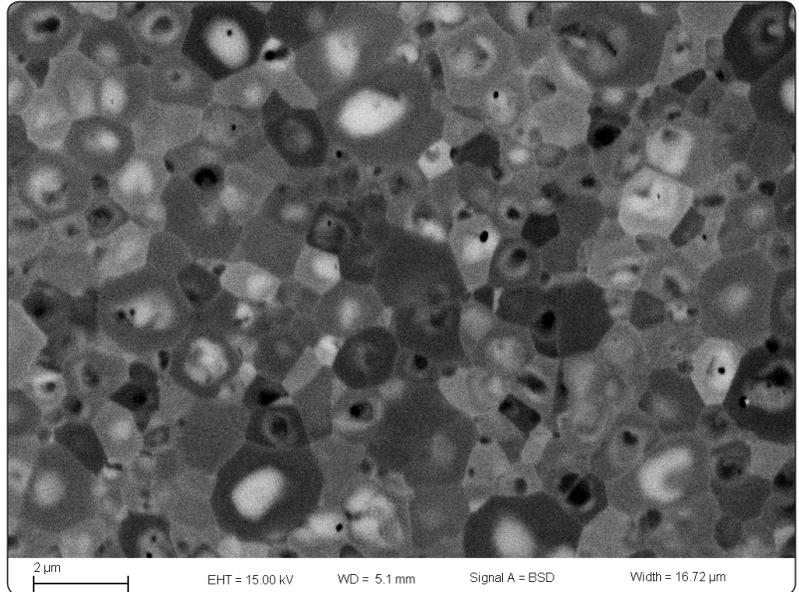
US Patent Application #62/096,608

Technology Readiness Level: 4-5

Basic technological components are integrated to establish that key elements will work together

TECHNOLOGY DESCRIPTION

Current dielectric materials are limited and unable to meet all operating, temperature, response frequency, size, and reliability requirements needed for uncooled high-reliability electronics. To address this problem, scientists at Sandia have developed a method for producing dielectric materials using engineered chemical disorder, creating semi-conductor material that outperforms what is currently available. By developing a composition with dissimilar cations ((Ba,Bi)(Zn,Ti)O₃), they created competing driving forces for crystallographic distortion resulting in a highly polarizable material. In addition to the structural distortion at the atomic level, the thermodynamics associated with mixing these systems lead to chemical disorder and gradients at the mesoscopic level during thermal processing. This multi-level chemical and structural frustration results in large permittivity level values that are stable across a wide range of operating temperatures (250°C+) and applied electric fields. In turn, Sandia's dielectric material possesses multiple advantages: 1) the material exists in a highly polarizable state; 2) results in a heterogeneous microstructure that aids in the dielectric properties; 3) high temperature resistivity; and 4) high temperature stability.



Multiscale chemical heterogeneity achieved through composition and processing

Capacitors based on Sandia's dielectric materials were developed for use in grid-tied storage; however, the resulting products will have various high operating temperature applications.

TECHNOLOGICAL BENEFITS

- Improvement of operating voltage and frequency
- Increased efficiency and reliability
- Eliminates the need for a cooling system
- Stable at high operating temperatures
- Reduced volume and cost

POTENTIAL APPLICATIONS

- Optoelectric– high voltage LEDs
- Energy grid
- Alternative energy generation
- Electric trains & cars
- Defense
- Down-hole electronics
- Oil & gas

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