MATERIALS SCIENCE AND ENGINEERING

SEMINAR

"MICROSTRUCTURE AND PIEZOELECTRIC PROPERTIES OF $Ba(Zr_{0.2}Ti_{0.8})O_3$-$x(Ba_{0.7}Ca_{0.3})TiO_3$ LEAD-FREE MATERIAL SYSTEM"

by

Binzhi Li
Purdue MSE MS Final
Professor Keith Bowman and Professor John Blendell

ABSTRACT

The recently discovered piezoelectric system based on barium zirconium titanate – barium calcium titanate (BZT-BCT) is a surprising addition to the potential for lead free materials. The optimum composition lying near the morphotropic phase boundary offers comparable piezoelectric properties to other high performance lead-based systems. In this research, the piezoelectric properties, crystal structure and domain motion were studied on this system to understand its ultra-high piezoelectricity. Based on in-situ temperature dependent x-ray diffractions study, detailed crystallographic information for tetragonal BZT-BCTs is obtained, and the phase transition temperature is determined. The measured piezoelectric and ferroelectric properties show a peak value at the optimum composition of BZT-50BCT. However, by changing the poling condition, a further improvement of piezoelectric properties can be achieved, which is proposed to be due to the development of internal bias field. In addition, high temperature performance of this system is investigated by studying the thermal depoling behavior of ferroelastic texture. Ferroelastic texture induced by poling is found to be not thermally stable but mechanical loading is an effective way to induce large scale of ferroeleastic domain motions that can persist well above Curie temperature. Furthermore, the microstructure origin of high electromechanical behavior of this system is studied by in situ electrical x-ray diffraction measurement. The contribution from extrinsic domain motion and intrinsic lattice strain to the macroscopic converse piezoelectric effect is resolved and discussed.

Date: Wednesday, July 13, 2011
Time: 2:00pm
Place: ARMS 3115

PURDUE MSE