PROGRESS REPORT FOR AINGRA06232

PROJECT TITLE: Domain switchability and fatigue in lead zirconate titanate (PZT) ceramic

INVESTIGATOR(S):

Chief Investigator: Professor Mark Hoffman
Institution and Department: Materials Science & Engineering, The University of New South Wales
Other Investigators: Dr. Jacob Jones, Dr. Andrew Studer, Mr. John Daniels, Mr Soodkhet Imlao
Students: Soodkhet Imlao, John Daniels
ANSTO Investigators: Dr Andrew Studer

SCIENTIFIC OBJECTIVES

1. To investigate the change of microstructure including domain switching, intrinsic strain (lattice strain) and extrinsic strain (domain switching strain) after a number of cycles of mechanical and electrical fatigue.
2. To investigate the effect of the amplitude and frequency of the electrical field on the fatigue behaviour of PZT by using in situ stroboscopic neutron diffraction.
3. To investigate the change of microstructure including intrinsic strain (lattice strain) and extrinsic strain (domain switching strain) after a number of cycles of electrical fatigue.
4. To develop the knowledge of the neutron diffraction technique for studying the behaviour of ferroelectric ceramics.

PROGRESS REPORT and RESEARCH OUTCOMES

DATA

The influence of the frequency and amplitude of cyclic mechanical loading on soft, tetragonal lead zirconate titanate (PZT) ceramics was investigated via neutron diffraction. The intensity change in the (200)pc reflections provided quantitative measurements of domain switching behavior, domain texture and the strain resulting from domain switching. It was found that the magnitude of applied stress affects the level of strain accumulated while its frequency affects the time taken for the strain to reach saturation. Furthermore we saw markedly different behaviors for poled versus unpoled samples. For samples loaded under identical conditions, the frequency effect is more pronounced in unpoled samples and the accumulated ferroelastic strain is greater in poled samples.
Fig. 2a

Fig. 2b
Fig. 2 shows diffracted spectra which were recorded from the different rotation angle ($\omega$) before and after applying mechanical loading (140/10 MPa); an unpoled sample at (a) $\omega = 0^\circ$ and (b) $\omega = 90^\circ$, a poled sample at (c) $\omega = 0^\circ$ and (d) $\omega = 90^\circ$. 
Fig. 3 presents the MRD values as a function of the rotational angle ($\omega$) to the compressive loading axis: the MRD values of (a) an unpoled, (b) a poled sample after 140/10 MPa loading, (c) an unpoled (d) a poled sample after 44/5.5 MPa (the data were fitted by polynomial function using Microsoft excel software).
Signature of Investigator preparing the report for
After signing this report please fax this page with your signature for our files

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PUBLICATIONS / REPORTS arising as a result of your work.

In preparation

PhD STUDENTS