Epitaxial Pb(Zr-x,Ti1-x)O-3 (0.30 <= x <= 0.63) films on (100)MgO substrates for energy harvesting applications

Author(s): C.B. Yeager[1] and S. Trolier-McKinstry[1,2]

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Abstract: Piezoelectric energy harvesting systems are of interest as a long-term power source for low-power wireless sensors. Transduction from elastic to electrical energy depends on the product of the piezoelectric charge and voltage coefficients; optimization of this figure of merit is an essential step towards improved microelectromechanical energy harvesting devices. This work reports on the composition dependence on the dielectric and piezoelectric properties of epitaxial {001}Pb(Zr-x, Ti1-x)O-3 films grown by chemical solution deposition and crystallized at 650 degrees C on (100)Pt//(100)MgO substrates for 0.63 <= x <= 0.30. The power generation figure of merit shows the greatest magnitude at compositions near x = 0.52, for which e(3I,f) = -12 C/m(2) and epsilon(r) = 420. Lattice parameters were determined as a function of [Zr] to assess when comparisons to single domain properties calculated from Landau-Devonshire theory were appropriate. Furthermore, films doped with 1 at. % Mn had the highest observed figure of merit, four times greater than of AlN. (C) 2012 American Institute of Physics.

Addresses:
1. Penn State Univ, Dept Mat Sci & Engn, University Pk, PA 16802 USA
2. Penn State Univ, Mat Res Inst, University Pk, PA 16802 USA