High-temperature Crystallized Thin-Film PZT on Thin Polyimide Substrates

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Flexible piezoelectric thin films on polymeric substrates provide advantages in sensing, actuating, and energy harvesting applications. However, direct deposition of many inorganic piezoelectric materials such as $Pb(Zr_{-x}, Ti_{1-x})O_{-3}$ (PZT) on polymers is challenging due to the high temperature required for crystallization. This paper describes a transfer process for PZT thin films. The PZT films are first grown on a high-temperature capable substrate such as platinum-coated silicon. After crystallization, a polymeric layer is added, and the polymer-PZT combination is removed from the high-temperature substrate by etching away a release layer, with the polymer layer then becoming the substrate. The released PZT on polyimide exhibits enhanced dielectric response due to reduction in substrate clamping after removal from the rigid substrate. For $Pb(Zr_{-0.52},Ti_{-0.48})(0.98)Nb_{0.02}O_3$ films, release from Si increased the remanent polarization from 17.5 mu C/cm(2) to 26 mu C/cm(2). In addition, poling led to increased ferroelastic/ferroelectric realignment in the released films. At 1 kHz, the average permittivity was measured to be around 1160 after release from Si with a loss tangent below 3%. Rayleigh measurements further confirmed the correlation between diminished substrate constraint and increased domain wall mobility in the released PZT films on polymers. Published by AIP Publishing.