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Domain Switching Characteristics of Lead Zirconate Titanate Piezoelectric Ceramic

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Abstract : To better understand the lattice characteristics of lead zirconate titanate (PZT) ceramics, the lattice orientations and domain-switching characteristics have been directly examined during loading and unloading using various experimental techniques. Upon loading, the PZT ceramics are fractured linear and nonlinearly during the compressive loading process. The strain characteristics of the PZT ceramic were directly affected by both the lattice and domain switching strain. Due to the piezoelectric ceramic, electrical activity of lightning-like behavior occurs in the PZT ceramics, which attributed to the severe domain-switching leading to weak piezoelectric property. The characteristics of domain-switching and reverse switching are detected during the loading and unloading processes. The amount of domain-switching depends on the grain, due to different stress levels. In addition, two patterns of 90˚ domain-switching systems are characterized, namely (i) 90˚ turn about the tetragonal c-axis and (ii) 90˚ rotation of the tetragonal a-axis. In this case, PZT ceramic was loaded by the thermal stress at 80°C. Extent of domain switching is related to the direction of c-axis of the tetragonal structure, e.g., that axis, orientated close to the loading direction, makes severe domain switching. It is considered that there is 90˚ domain switching, but in actual, the angle of domain switching is less than 90˚, e.g., 85.4° ~ 90.0°. In situ TEM observation of the domain switching characteristics of PZT ceramic has been conducted with increasing the sample temperature from 25°C to 300°C, and the domain switching like behavior is directly observed from the lattice image, where the severe domain switching occurs less than 100°C.

Keywords : PZT, lead zirconate titanate, piezoelectric ceramic, domain switching, material property
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