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Mechanism of significantly enhanced piezoelectric performance and stability in textured potassium-sodium niobate piezoelectric ceramics

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Abstract

In this study, the piezoelectric coefficient d_{33} and planar electromechanical coupling coefficient k_p were enhanced 145% and 71%, respectively for the $\langle 001 \rangle$ -textured $(\text{K}_{0.5}\text{Na}_{0.5})_{0.95}\text{Li}_{0.05}\text{Nb}_{0.93}\text{Sb}_{0.07}\text{O}_3$ piezoelectric ceramics compared with their randomly oriented counterpart. Significantly enhanced piezoelectric response in textured ceramics is originated from a combined effect of the intrinsic high piezoelectric activity of $\langle 001 \rangle$ -oriented grains in the tetragonal-orthorhombic phases, and easy polarization rotation of fine domains. Furthermore, a comparative analysis suggests that $\langle 001 \rangle$ -textured ceramics exhibit good thermal stability, benefiting from the weakened depolarization behavior via crystal orientation. The superior fatigue resistance in textured ceramics can be attributed to the reduced clamping effect as low defect density. These results show that high-performance textured ceramics reported in this work will be promising candidates in the field of lead-free piezoelectric materials.

Keywords: Potassium-Sodium Niobate; Texture; Piezoelectric response; Stability

1. Introduction

Piezoelectrics with the interconversion function between electrical and mechanical energy have been widely used in transducers, actuators, and sensors, etc[1-5]. Lead-based piezoelectric materials, especially PZT have always firmly occupied the dominant position in the piezoelectric market due to their excellent electromechanical performance[6]. However, the dumped electronic devices containing Pb are harmful to

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