Development of Textured Lead Zirconate Titanate (PZT) Ceramics for Passive Acoustic Sensing Applications

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Abstract: Passive acoustic devices utilizing conventional ceramics, such as PZT-4, possess limited hydrostatic sensitivity due to a low piezoelectric voltage coefficient (g_H). This work is developing [001] textured lead zirconate titanate (PZT) ceramics that display enhanced hydrostatic acoustic sensitivity. This work studies the key process conditions required to promote the templated grain growth (TGG) process in the PZT system. The effects of powder pre-reaction on phase uniformity and particle size are explored to maximize the driving force for TGG. The viability of chemical solution deposition of PZT on particles with plate-like morphology is also explored to facilitate in-situ epitaxial growth of PZT ceramic during sintering. Densification and grain growth of templated-PZT structures are explored, and the influence of crystallographic orientation on the longitudinal (g_{33}) and transverse (g_{31}) voltage sensitivity is discussed. Finally, the effects of hysteresis and domain wall motion in textured versus random ceramic PZT are discussed.