

# Experimental Analysis of 1-3 Piezocomposites for High-Intensity Focused Ultrasound Transducer Applications

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## Abstract

Abstract—Piezocomposites with 1-3 connectivity have been extensively used in medical imaging transducers and high-intensity focused ultrasound transducers, but most studies of 1-3 piezocomposites address medical imaging applications. The purpose of this study was to completely investigate 1-3 composites specifically for high-power ultrasonic transducer applications via a series of experimental analyses. PZT4-epoxy composite focused transducers with various aspect ratios and volume fractions were constructed in-house for the evaluation of the coupling factor, dielectric loss tangent, quality factor, bandwidth, acoustic impedance, and electroacoustic efficiency. The experimental analyses demonstrated that although the coupling factor of composite transducers was higher than that of the ceramic transducer, the composite transducers had a lower efficiency due to the high dielectric loss and high mechanical energy loss of the composites. In addition, the bandwidth and acoustic impedance of composite transducers were superior to the ceramic transducer. For the composite transducers, the efficiency and acoustic impedance were inversely proportional to the aspect ratio and linearly proportional to the volume fraction. The coupling of inter pillars that are too close to each other could cause a significant decrease in the efficiency of the composite transducer. With an appropriate design in terms of the aspect ratio, volume fraction, and PZT-pillar spacing, a high-efficiency composite highintensity focused ultrasound transducer can be achieved.

Keyword : High intensity, Piezocomposites, Transducer, Ultrasound