

Piezoelectric Composites of Fine PZT Rods Realized by LIGA Process

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A ceramic microfabrication process has been developed for a 1–3 piezoelectric composite. This composite material was predicted to be suitable for high-frequency and wideband ultrasonic transducers used in diagnostic medicine and nondestructive testing. However, no process was available to fabricate micro- and high-aspect-ratio lead zirconate titanate (PZT) columnar arrays; therefore, a piezoelectric composite for high-frequency ultrasonic transducers was not realized. We developed a process which employs synchrotron radiation (SR) lithography, electroforming, and micromolding, generally called the “LIGA process.” This process produced an array of PZT columns whose cross-sectional area is $25 \mu\text{m}^2$ and $250 \mu\text{m}$ high. As expected from theory, the mechanical quality factor (Q_m) is lower and the electromechanical coupling coefficient in the thick mode (k_t) is higher than conventional materials. Using the composite developed in an ultrasonic endoscope, the ultrasonic pulse-width was improved from 240 ns to 180 ns, and the bandwidth was expanded from 60% to 150%.

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