High performance thin film PZT ultrasonic transducer by CSD for distance measurements in water

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ABSTRACT

Piezoelectric thin film ultrasonic transducer was realised and tested for short range distance measurements in water. The transducer structure (154 x 154 μm^2) utilising electric field excitation in thickness and transversal direction by special electrode layout was designed. Displacement and acoustic response in air and water was modelled by FEMLab and structure was adjusted to obtain resonance frequency in 5 MHz in air and ~3 MHz in water. The transducer was fabricated on SOI wafer by chemical solution deposition (CSD) where 32 sequential layers of PZT were deposited with the total thickness of 2 µm. Subsequently, a cavity underneath the piezoelectric layer was wet etched creating a bending membrane with total thickness of ~12 µm. The ultrasonic transducer was poled with 10 V/µm electric field at 150 °C temperature obtaining an effective transversal piezoelectric coefficient of -15 C/m^2 [1].
After poling the displacement of the unimorph was measured as a function of frequency by fiber-optic laser vibrometer and admittance of the transducer was measured by network analyser in air and water. Performance improvement for conventional electrode design was estimated and modelling and measurement results were compared.

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