

Fabrication of Ultrasonic Transducers Using Epitaxial Pb(Zr,Ti)O₃ Thin Films on Epitaxial γ -Al₂O₃/Si Substrates for Smart Sensors

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Ultrasonic transducers using epitaxial Pb(Zr,Ti)O₃ (PZT) thin films on epitaxial γ -Al₂O₃/Si substrates were successfully fabricated for the first time. The characteristics of PZT thin films on the γ -Al₂O₃/Si substrates were investigated. 240-nm-thick PZT films with various compositions were formed by the conventional sol-gel method. All PZT films were epitaxially grown on the substrates and exhibited ferroelectric and piezoelectric characteristics. Ultrasonic transducers were fabricated on the epitaxial γ -Al₂O₃(001)/Si(001) substrates with transducer element of 1 mm square. The transmission and reception characteristics of the ultrasonic transducers were observed in water by a hydrophone. Fabricated transducers can transmit and receive an ultrasonic wave with frequency of 2.5 MHz at distances of 15 and 20 mm. From these results, ultrasonic transducers with the epitaxial PZT/Pt/ γ -Al₂O₃/Si structure can be applied to Si monolithic ultrasonic smart sensors.

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