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High Performance Ring Hydrophone Based On <001>-oriented Pb(in1/2nb1/2)o3–pb(mg1nb2/3)o3–pbtio3 Textured Ceramics

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Abstract : Textured perovskite ferroelectric ceramics have attracted considerable attention due to their high piezoelectric, electromechanical performance, as well as their unique near-zero Poisson's ratio characteristic. This study focuses on a ring hydrophone constructed using <001>-oriented Pb(In1/2Nb1/2)O3–Pb(Mg1/3Nb2/3)O3–PbTiO3 (PIN-PMN-PT) textured ceramics. The impact of the near-zero Poisson's ratio on the cooperative and counteracting effects among multiple vibration modes in the ring has been investigated. Subsequently, an electromechanical equivalent circuit model for the ring hydrophone was developed, revealing the relationship between structural parameters and the amplitude-frequency characteristics of each vibration mode. Finally, a ring hydrophone with enhanced receiving voltage sensitivity was designed and fabricated. The results indicate that the near-zero Poisson's ratio of the circumferential ring facilitates decoupling among radial, height, and thickness vibration modes, enabling the achievement of a pure radial vibration mode without interference from parasitic modes. This contributes to a high and flat receiving voltage sensitivity. Ultimately, the ring hydrophone constructed from PIN-PMN-PT textured ceramics exhibited a receiving voltage sensitivity exceeding that of traditional PZT piezoelectric ceramic counterparts by more than 4dB.

Keywords : textured ceramics, near-zero poisson’s ratio, hydrophone, high receiving voltage sensitivity
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