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Langasite Membranes for Surface Acoustic Wave Pressure Sensors

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On the basis of the electroelastic perturbation model, which includes electrical perturbation items, a doubly rotated cut area of langasite (LGS) defined by the Euler angles ϕ, from 137° to 160°, and ψ, from 18° to 25°, is proposed as a design for pressure sensors because it has good temperature stability (TCD < 10 ppm), high electromechanical coupling coefficients ($k^2 > 0.4\%$) and relatively high pressure sensitivity ($6–8 \times 10^{-12}/(Pa \cdot (R/h)^2)$). Differential surface acoustic wave resonators made of LGS (0°, 150° and 22°) have been fabricated and tested. The measured fractional frequency changes among the differential resonators vs pressure from 0 to 0.6 MPa verify that the experimental relative sensitivity is 3.7×10^{-10} fractional frequency change per Pa, which is in agreement with the calculated prediction. The temperature dependence is within 2.5 kHz/°C in the range from 20°C to 100°C.

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