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Fabrication of High-Q FBAR with Mesa-Shaped Membrane Structure

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In this paper, we present a newly developed high-Q film bulk acoustic resonator (FBAR), which has a piezoelectric AlN film sandwiched between two electrode films and a mesa-shaped membrane structure by utilizing polysilicon and XeF_2 as a sacrificial layer and dry release gas, respectively. By controlling the etching profile of the bottom-electrode and the sacrificial layers, the growth of a poorly formed AlN layer at the edge of the mesa-shaped membrane could be eliminated. Moreover, by optimizing the space between the sacrificial layer and the top/bottom-electrode layer, we could improve the characteristics of the resonator and filter. When we compare our new FBAR with a typical surface-micromachined FBAR, such as a resonator having its own Bragg reflector or cavity, we can greatly reduce the need for the tight control of chemical mechanical polishing (CMP) of the layer underneath the resonator. The measured Q value and the effective electromechanical coupling coefficient of the resonator with an area of 120×120 μm^2 were 1450 and 6.43%, respectively. The peak insertion loss (IL) and the bandwidth of the filter were 0.60 dB and 70 MHz, respectively.

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