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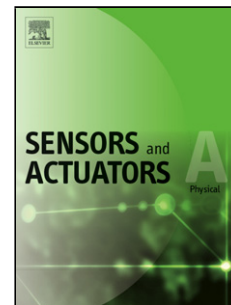
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Investigation of Sacrificial Layer Masking Fabrication of Dual-Frequency Quartz Crystal Microbalance

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Highlights for review

- dual-channel/frequency QCM-on-a-chip
- tunable frequencies on one-chip monolithic device
- precise micro-nano scale structure fabrications

Abstract: To solve temperature compensation problems and eliminate environmental impact factors for quartz crystal resonators, a study on one-chip inverted mesa multi-channel/frequency quartz crystal microbalance (MQCM) was presented. MQCM was fabricated by a simple, precision controlled and plasma-ion-beam etching technique. The research intention was devoted to etching nanometer-scale depth inverted mesa of a quartz wafer using aluminum (Al) as a sacrificial layer. The masking method was demonstrated with 0.497 mA/cm^2 ion-beam density, 300 eV argon-ion energy and $1.0 \text{ }\mu\text{m/h}$ etching rate. Both morphology of etched surface and its depth were characterized by laser scanning confocal microscope (LSCM). Resonant frequencies of a fabricated MQCM indicated that the thinning approach demonstrated will fine tune relevant QCM resonant frequency as proposed. The one-chip dual-QCM in the case of $3.28 \text{ }\mu\text{m}$ depth etching would result in its fundamental resonance peak shifted at 0.5054 MHz. The inverted mesa etched at micron level significantly will provide fine-tunable frequencies on one-chip monolithic device fabricated. The simple adhesion-type Al sacrificial layer masking method and plasma etching technique do have great potential for precise micro-nano scale structure fabrications.

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