High-frequency micromechanical columnar resonators

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Abstract. High-frequency silicon columnar microresonators are fabricated using a simple but effective technological scheme. An optimized fabrication scheme was invented to obtain mechanically protected microcolumns with lateral dimensions controlled on a scale of at least 1 μm. In this paper, we investigate the influence of the environmental conditions on the mechanical resonator properties. At ambient conditions, we observed a frequency stability $\delta f/f$ of less than 10^{-6} during 5 h of operation at almost constant temperature. However, varying the temperature shifts the frequency by approximately -173 Hz $°C^{-1}$. In accordance with a viscous damping model of the ambient gas, we perceived that the quality factor of the first flexural mode decreased with the inverse of the square root of pressure. However, in the low-pressure regime, a linear dependence was observed. We also investigated the influence of the type of the immersing gas on the resonant frequency.

Keywords: microresonator, microcolumn, frequency stability, mass sensor, resonators in viscous fluids, molecular mass, cantilever

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