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Micro-Oscillators for Ultra-Sensitive Force Detectors[1] WEI LU, JOHN MARKERT, Physics Department, University of Texas at Austin — Recently, we have improved the microfabrication process for ultra-sensitive double-torsional mechanical micro-oscillators. Starting with silicon-on-insulator wafers (with 300 nm Si surface layers), we grow a protective layer of oxide, then pattern 2-mm × 0.5-mm "windows" that result in a thin Si film after two-sided wet chemical etching. Patterning these film windows with electron-beam lithography then provides the final micro- oscillator structures. Our designs include multimode structures, particularly double-torsional modes; we have achieved excellent geometric symmetry and small sizes ($\sim$ 30 μm laterally and 300 nm thick). These oscillators have excellent force sensitivity, yet provide stronger mechanical structures than typical ultrafloppy cantilevers designs. For example, an antisymmetric double-cantilever mode provides a minimum detectable force of 1.6×10^{-16} N/$\sqrt{\text{Hz}}$ at room temperature, corresponding to $F_{\text{min}} = 5 \times 10^{-18}$ N/$\sqrt{\text{Hz}}$ at ^{3}He temperatures. A double torsional mode typically provides enhanced sensitivity, so minimum detectable forces on the order of 10^{-19}–10^{-20} N/$\sqrt{\text{Hz}}$ are now targeted.

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