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Silicon Integrated Cavity Optomechanical Transducer JIE ZOU, HOUXUN MIAO, THOMAS MICHELS, YUXIANG LIU, National Institute of Standards and Technology; University of Maryland, KARTIK SRINIVASAN, VLADIMIR AKSYUK, National Institute of Standards and Technology — Cavity optomechanics enables measurements of mechanical motion at the fundamental limits of precision imposed by quantum mechanics. However, the need to align and couple devices to off-chip optical components hinders development, miniaturization and broader application of ultrahigh sensitivity chip-scale optomechanical transducers. Here we demonstrate a fully integrated and optical fiber pigtailed optomechanical transducer with a high Q silicon micro-disk cavity near-field coupled to a nanoscale cantilever. We detect the motion of the cantilever by measuring the resonant frequency shift of the whispering gallery mode of the micro-disk. The sensitivity near the standard quantum limit can be reached with sub-uW optical power. Our on-chip approach combines compactness and stability with great design flexibility: the geometry of the micro-disk and cantilever can be tailored to optimize the mechanical/optical Q factors and tune the mechanical frequency over two orders of magnitudes. Electrical transduction in addition to optical transduction was also demonstrated and both can be used to effectively cool the cantilever. Moreover, cantilevers with sharp tips overhanging the chip edge were fabricated to potentially allow the mechanical cantilever to be coupled to a wide range of off-chip systems, such as spins, DNA, nanostructures and atoms on clean surfaces.

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