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Using a quantum point contact as a sensitive detector of cantilever motion M. POGGIO, M.P. JURA, C.L. DEGEN, M.A. TOPINKA, H.J. MAMIN, D. GOLDHABER-GORDON, D. RUGAR, IBM RESEARCH DIVISION, ALMADEN RESEACH CENTER, 650 HARRY RD., SAN JOSE, CA COLLABORATION, CENTER FOR PROBING THE NANOSCALE, STANFORD UNIVERSITY, 476 LOMITA HALL, STANFORD, CA COLLABORATION — We demonstrate the use of a GaAs quantum point contact (QPC) as a sensitive displacement detector with the ability to resolve the thermal motion of an ultrasoft micromechanical oscillator. The displacement measurement is made by positioning the tip of a metal-coated Si cantilever ~ 100 nm above a QPC. The application of a small voltage to the lever causes it to gate the conductance through the QPC. As a result, motion of the cantilever's tip modulates the conductance. By measuring this modulation, we achieve a displacement resolution better than 10^{-12} m/Hz^{1/2}, which is comparable to the resolution achieved by low power optical interferometry. The flexibility of an on-chip QPC as a sensor of cantilever displacement has a number of potential applications including magnetic resonance force microscopy, the detection of displacement for cantilevers with dimensions smaller than the optical diffraction limit, and the cooling of mechanical resonators through feedback.

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