Highlights

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Noncontact Atomic Force Microscope Dissipation Reveals a Central Peak of $SrTiO_3$ Structural Phase Transition

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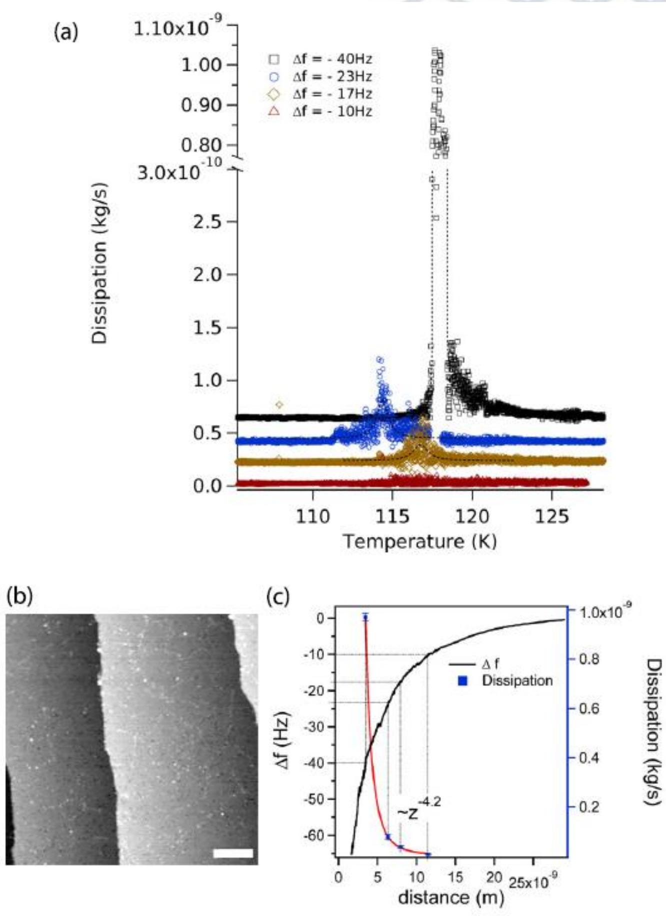
The critical fluctuations at second order structural transitions in a bulk crystal may affect the dissipation of mechanical probes even if completely external to the crystal surface. Here, we show that noncontact force microscope dissipation bears clear evidence of the antiferrodistortive phase transition of $SrTiO_3$, known for a long time to exhibit a unique, extremely narrow neutron scattering "central peak." The noncontact geometry suggests a central peak linear response coupling connected with strain. The detailed temperature dependence reveals for the first time the intrinsic central peak width of order 80 kHz, 2 orders of magnitude below the established neutron upper bound.



(a) Experimental AFM dissipation W as a function of temperature. Raw data, taken at different surface spots and different tip sample distances z. The sharp peak corresponds to the critical temperature of $SrTiO_3$ in the bulk region under the tip. (b) Low temperature (T = 5 K) STM image of $SrTiO_3$ (100) surface. The image is obtained at constant current I = 10 pA and bias voltage U = 1 V. The length of the scale bar is equal to 20 nm. (c) The distance dependence of the dissipation W, taken as the maximum of the peak shown in (a), at four different spots on the sample. A fit to the experimental data, $W \propto z^{-p}$, is shown in red, with $p \sim 4.2$. This exponent is close to the value p = 4 expected for phononic dissipation, as appropriate for coupling to acoustical surface fluctuations of an insulating bulk material.