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Dissipation and feedback cooling of graphene and MoS_2 nanomechanical resonators RONALD VAN LEEUWEN, GARY STEELE, WARNER VENSTRA, HERRE VAN DER ZANT, Delft Univ of Tech, KAVLI INSTITUTE OF NANOSCIENCE TEAM — The interesting mechanical and electronic properties of 2-dimensional materials make them candidates for nano-electromechanical systems. Remarkably, the mechanical resonance linewidth of such suspended structures is found to be invariably low at room temperature. Time-domain measurements were used as a tool to differentiate between dissipation and non-dissipative frequency fluctuations, thus providing more insight in the origin of the low linewidth. We perform time-domain measurements on MoS_2 resonators with thickness down to a single layer, and compare the relaxation times obtained from ringdown measurements to the resonance linewidth obtained from Brownian motion and driven frequency responses. We conclude that dephasing plays a negligible role at room temperature, and that the spectral line-width is bounded by dissipation. To modify the damping we introduce an optical feedback technique. We demonstrate continuous tuning of the oscillator linewidth, by modifying the linewidth over 2 orders of magnitude. Feedback also enables cooling of the fundamental mode of graphene and MoS_2 drum resonators down to an effective temperature of 100 K.

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