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Thermal control of tension in suspended 2D materials DEJAN DAVIDOVIKJ, HERRE S. J. VAN DER ZANT, PETER G. STEENEKEN, Delft Univ of Tech — We demonstrate tuning of the resonance frequency of graphene nanodrums by more than 30 % using current-controlled on-chip heaters. Interestingly, the tension-induced frequency change is accompanied by an increase of the mechanical quality factor by 100 %. Our devices consist of circular metallic heaters on a substrate with cavities, on top of which we suspend graphene flakes. Depending on the difference of the thermal expansion coefficient between the metal and the 2D material, upon heating, the drum experiences a compressive or tensile strain. The negative thermal expansion coefficient of graphene further amplifies the tension tunability. The observed increase of the quality factor is in contrast to measurements involving electrostatic pulling, where the Q-factor is always observed to decrease with increasing gate voltage. The origins of the low intrinsic quality factor of two-dimensional nanodrums are still poorly understood and the reason for its drastic increase at low temperatures is still unknown. The presented on-chip heating method provides control over tension and resonance frequency in 2D nanoresonators, which is useful in applications like sensors and resonant mechanical filters and can also shed light on the origin of dissipation in suspended 2D materials.

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