Energy Dissipation in Nano-electro-mechanical Devices at Millikelvin Temperatures

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We report on experiments performed at dilution temperatures on nano-electro-mechanical goalpost devices [1]. The structures are made of silicon covered with a thin layer of aluminum, and resonate around 10 MHz in their first flexural mode. We have measured in vacuum ($P < 10^{-6}$ mbar) and under small magnetic fields ($B < 1$ T) the mechanical intrinsic dissipation experienced by the device in this first mode, for both the normal and superconducting states of its metallic coating. In the superconducting state, strong nonlinear effects have been discovered. Furthermore, the damping in the superconducting state becomes much smaller at low temperatures than in the normal state, proving that conduction electrons play a key role in the dissipation mechanism. The dissipative component becomes vanishingly small at very low temperatures in the superconducting state, leading to Q factors of about a million, which is exceptional for such small silicon structures.

[1] K.J. Lulla et al., *Phys. Rev. Lett.* **110**, 177206 (2013).

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