Supplementary information

High-frequency nanotube mechanical resonators

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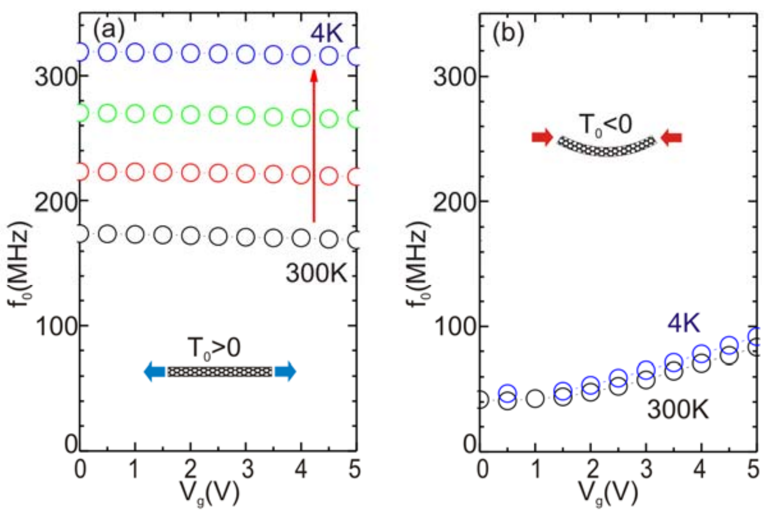

Fig. 1S(a) Resonance frequency of a nanotube under tensile stress as a function of V_g for various T (4, 91, 153, and 300K). (b) Same measurement as in (a) for a nanotube with slack. We present only the data of the lowest measured resonance. The nanotubes in (a) and (b) are the same as those in Fig. 3a.

Figure 1Sa shows the resonance frequency as a function of V_g (applied on the backgate) at different temperatures and for a device fabricated with the process described in the main text and having contact electrodes separated by ~640 nm. The resonance frequency is weakly sensitive to V_g. This V_g dependence of f_0 differs greatly from what is measured in nanotube resonators with slack (Fig. 1Sb) where $\delta f_0 / f_0$ is much larger and positive. The latter behavior is well-documented and is attributed to the tension T_e that builds in the nanotube as it bends towards the backgate upon increasing V_g [1,2,3]. The fact that this behavior is not observed in the resonators fabricated with the process described in this paper (Fig. 1Sa) is an indication that the nanotube is under tensile stress and that the built-in tension T_0 is much larger than T_e ($T_0 >> T_e$ since $f_0 \propto \sqrt{T_0 + T_e}$ for a beam under tensile stress and that f_0 is not affected by the tension induced by the electrostatic force).

References

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