Frequency tuning and stability of atomically thin nanomechanical resonators

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The rich properties of atomic layer crystals enable researchers to design and fabricate micro/ nano-electromechanical devices and systems towards signal processing and sensing application[1]. We fabricate graphene NEMS resonator and perform resonance measurement by our customized set-up (fig.1). The frequency tuning and resonance curve of device are shown in fig.2 and fig.3, respectively. The long-term measurement of the device's frequency stability over 60 hours indicates a frequency deviation of 0.47% in the '0' or '1' state, which is much smaller than the frequency shift between the two states, which is 60.21%.

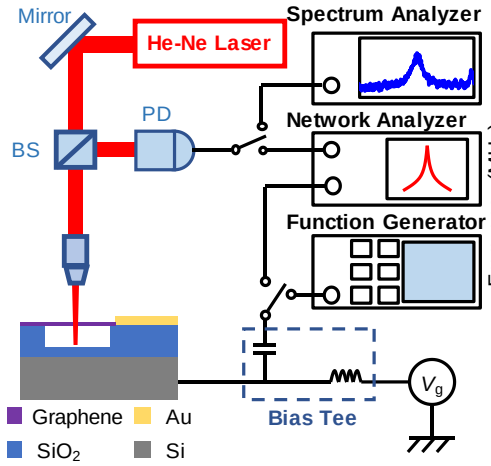

Fig. 1: The customized-built set-up with electrical excitation and optical detection.

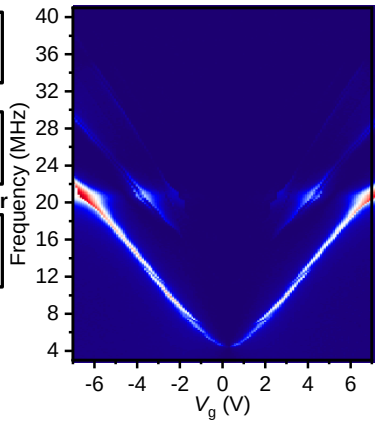

Fig. 2: Frequency tuning of the graphene NEMS resonator when AC driving v_{ac}=20 mV.

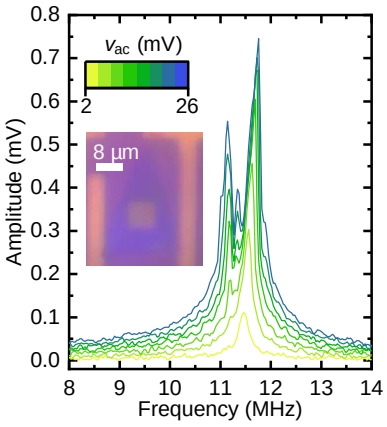

Fig. 3 The spectrum response with increasing AC driving v_{ac} from 2 to 26 mV at V_g= 4 V.

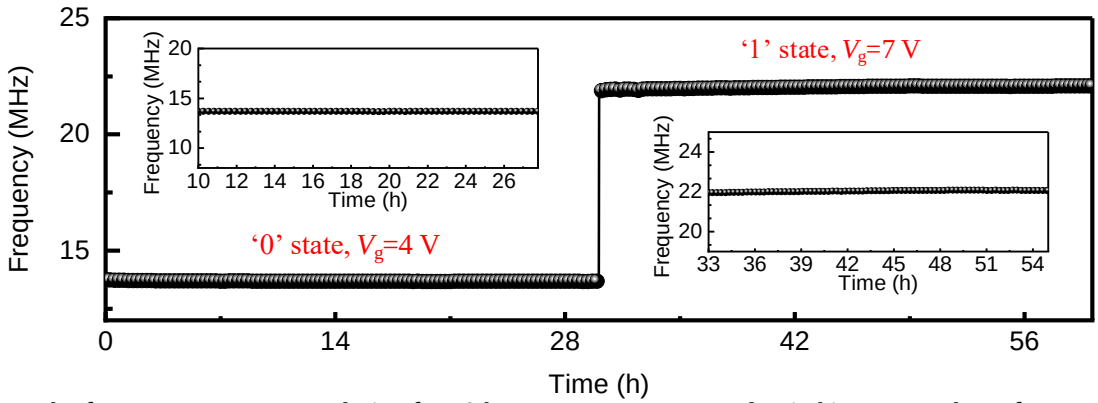

Fig. 4 : The frequency spectrum evolution for 60 hours measurements and switching gate voltage from 4 V to 7 V at 29.8 h.

[1] J. Lee, et al., "Electrically tunable single-and few-layer MoS_2 nanoelectromechanical systems with broad dynamic range" Sci. Adv., 4, eaao6653, 2018.