Strong coupling and parametric amplification in mechanical modes of graphene drum resonators

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Abstract Graphene based nanomechanical devices are of interest for applications as well as fundamental studies. We demonstrate [1] strong dynamical coupling and parametric amplification in mechanical modes of a graphene drum using an all electrical configuration. Low tension in the system allows large electrostatic tunability of the modes thus enabling dynamic pumping experiments. In the strong coupling regime a red detuned pump gives rise to new eigenmodes having highly tunable mode splitting (cooperativity ~ 60) with coherent energy transfer. The coupling is also used to amplify the modes under the action of a blue detuned pump. In addition, self-oscillations and parametric amplification of the fundamental vibrational mode is demonstrated with a gain of nearly 3. The low mass and high frequency of these atomically thin resonators could prove useful for studying mode coupling in the quantum regime.

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References

[1] John P Mathew, Raj Patel, Abhinandan Borah, R. Vijay, Mandar M Deshmukh
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Figures