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Graphene Mechanics and NEMS

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Graphene is an ideal material for nano-electromechanical devices (NEMS) due to properties such as high mobility, low density, and ultrahigh stiffness and strength. We have previously used nanoindentation to show that graphene has an ultimate strength of 130 GPa at an ultimate strain of over 25%. We have also measured the elastic stiffness and strength of related materials, including hydrogenated graphene (graphane), BN, and MoS₂. We have measured the resonant response of graphene NEMS using an electromechanical mixing technique. Toward development of applications, we have measured the response of the devices to changes in tension, mass, and temperature; the temperature-dependent resonant frequency can be used to measure the negative thermal expansion coefficient from 20 K to 300K.