Keynote

Mechanical resonators based on nanotubes and graphene

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Carbon nanotubes and graphene offer unique scientific and technological opportunities as nanoelectromechanical systems (NEMS). Namely, they have allowed the fabrication of mechanical resonators that can be operable at ultra-high frequencies and that can feature high quality factors. In addition, nanotubes and graphene have exceptional electron transport properties, including ballistic conduction over long distances. Coupling the mechanical motion to electron transport in these remarkable materials is thus highly appealing. Here, I will review some of our recent results on nanotube and graphene resonators, including mass sensing at the proton mass level [1], force sensing with ~10 zN/Hz1/2 noise [2], and the measurement of quality factors up to 5 million [3].

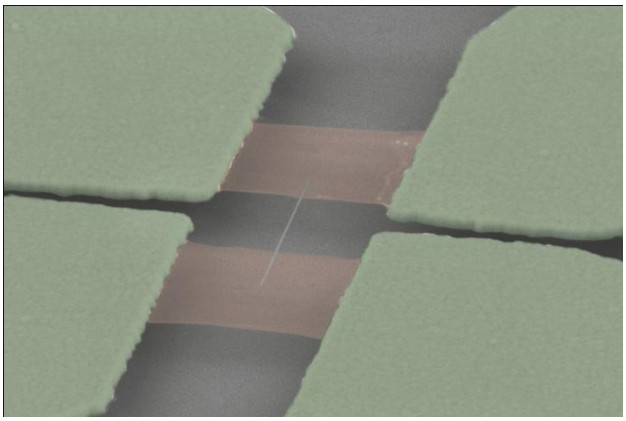

Figure 1. Suspended multi-element all-carbon vibrational structure, which consists of two graphene mechanical resonators coupled by a multi-wall nanotube beam.

References

[1] J. Chaste, A. Eichler, J. Moser, G. Ceballos, R. Rurali, A. Bachtold, Nature Nanotechnology 7, 301 (2012).

[2] J. Moser, J. Güttinger, A. Eichler, M. J. Esplandiu, D. E. Liu, M. I. Dykman, A. Bachtold, Nature Nanotechnology 8, 493 (2013).

[3] J. Moser, A. Eichler, J. Güttinger, M. I. Dykman, A. Bachtold, Nature Nanotechnology, in press.