Temperature dependent resistivity due to flexural phonons in single and bilayer graphene

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The two-dimensional allotrope of carbon – graphene – has been attracting considerable attention since the first flake was isolated in 2004. The enormous interest is driven equally by the unconventional low-energy behavior (massless Dirac quasiparticles) and potential technological applications. Regarding the latter, the giant intrinsic carrier mobility observed in suspended graphene (free of substrate induced limitations) is certainly an asset. The reported big numbers, however, show up only at low temperatures; at room temperature mobility falls into the values reported for non-suspended samples. Here we explore the effect of flexural phonons – out-of-plane vibrations of the graphene membrane – on the resistivity's temperature dependence of doped suspended single and bilayer graphene. It is shown that flexural acoustic phonons give the major scattering contribution at room temperature, and indeed limit mobility to values known for samples on substrate. It is also shown that scattering by flexural phonons is completely suppressed by applying realistic strain, opening the way to promising strain engineering applications to graphene.