Mobility of suspended bilayer graphene at finite temperature

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Recent realization of suspended monolayer [1, 2] and bilayer [3] graphene samples made possible a direct probe of the intrinsic, unusual properties of these systems. In particular, intrinsic scattering mechanisms limiting mobility may now be unveiled [4]. In a recent publication we have shown [5] that in suspended, non-strained monolayer graphene room temperature mobility is limited to values observed for samples on substrate due to scattering by out of plane – flexural – acoustic phonons. This limitation can, however, be avoided by applying tension. Bilayer graphene has a different low energy electronic behavior as well as different electron-phonon coupling. It is then natural to wonder what is the situation in the bilayer regarding electron scattering by acoustic phonons, and in particular by flexural phonons.

In the present contribution, after reviewing the single layer graphene case, we will present our recent results for scattering by both acoustic in-plane phonons and flexural phonons in doped, suspended bilayer graphene. We have found the bilayer membrane to follow the qualitative behavior of the monolayer cousin [5]. Different electronic structure combine with different electron-phonon coupling to give the same parametric dependence in resistivity, and in particular the same temperature behavior. In parallel with the single layer, flexural phonons dominate the phonon contribution to resistivity in the absence of strain, where a density independent mobility is obtained. This contribution is strongly suppressed by tension, similarly to monolayer graphene [5]. However, an interesting quantitative difference with respect to suspended monolayer has been found. In the latter, as shown in [5], flexural phonons limit room temperature mobility to values obtained for samples on substrate,.~1 $m^2/(Vs)$, when tension is absent. In bilayer, quantitative differences in electron-phonon coupling and elastic constants lead to a room temperature mobility enhanced by one order of magnitude, ~10–20 $m^2/(Vs)$, even in non-strained samples. This finding has obvious advantages for electronic applications.

References

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