Inelastic Scattering Probed by Weak Localization in a Monolayer Graphene Sheet

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Graphene, single layer of graphite, possesses remarkable electronic transport properties compared with other solid-state two-dimensional systems. Its novel feature arises from the linear dispersion relation near the of undoped-state Fermi level. Correction to the charge conductivity is known to leads to anti-weak localization in graphene by the chirality-conserving elastic scattering. [1]. However, in real graphene sheets the conventional weak localization is observed to be restored by the chirality-breaking intervalley scattering [2]. In this study, we focused on studying inelastic scattering characteristics in graphene, where the large elastic intervalley scattering reveal the conventional weak-localization conductivity correction. We fabricated a Hall-bar-patterned 1-um-wide graphene sheet and measured weak-localization properties at various gate voltage and temperatures by using four-probe measurement technique. Inelastic (L_φ) and elastic (L_i, L_*) scattering lengths were deduced from theoretically suggested expression for weak-localization in graphene [3]. In our sample, elastic intravally and intervally scattering are strong by atomically sharp defects so that $L_\varphi \gg L_i \geq L_*$. This condition of relative characteristic length scales is different from those of the previous studies by Morozov *et al* ($L_i \gg L_\varphi \gg L_*$.) and Tikhoneneko *et al* ($L_\varphi \sim L_i \gg L_*$). The unusual voltage and temperature dependencies can be explained by dominant inelastic electron-electron scattering in our sample and additional inelastic scattering by electron-hole puddle near the Dirac point.

Keywords: Graphene, Weak localization, Chirality, inelastic scattering, intervalley scattering