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Improvement of Graphene-Metal Contacts by Current-Induced Cleaning

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The issue of contact resistance between graphene and metal contacts is crucial in the development of high-speed graphene devices. However, fabrication-related contamination severely affects the contact resistance in graphene and hence an effective post-fabrication method is needed to resolve this problem. Current-induced cleaning has previously been used successfully to clean the surface of graphene using the concepts of Joule heating. However, its effect on the graphene-metal contact resistance has not been well documented. By studying as many as 20 devices with varying sample sizes and geometry, we demonstrate that current-induced annealing may be used as an effective in-situ annealing procedure to improve the graphene-metal contact resistance which has long been an issue in characterizing graphene-based devices. With this technique, we are able to reduce the overall resistance systematically to around 1000 Ω µm, which is competitive with the best values obtained in the literature to treat this problem. We also demonstrate the effectiveness of current annealing in desorbing contaminants from the surface of the graphene layer, simultaneously shifting the charge-neutrality point to zero back-gate voltage, thus allowing the tuning of carrier density on both the electron and hole sides of the Dirac spectrum. Finally, we highlight certain high-bias effects such as electro-migration that may prove to be detrimental to the operation of these devices.

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