Role of surface charge transfer doping in graphene spin devices

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As tunnel barriers, ultrathin metal-oxide layers on graphene are essential to graphene spintronic devices [1-3]. In this work, we make a systematic investigation of the impact of metal-oxides on the electronic properties of graphene. For this study, graphene-based spintronic devices were prepared using large-scale chemical vapor deposited graphene for its potential for the scalability and practicality of graphene spintronics. To reveal the true impact of metal oxides layers on graphene, electrical measurements were performed on the same graphene spin devices, both before and after metal oxide layer realization. Even though the differences between the tunnel barrier layers on graphene were usually not considered, different metal oxides showed distinct effects on electrical characteristics such as sheet resistance, mobility, and Dirac point shift. A significant shift in Fermi level and type of conductivity were observed. These results were corroborated with Raman and X-ray photoelectron spectroscopy, which revealed contributions arising from defects in metal-oxide covered graphene. We also observe topographic features that are distinct to the specific nature of the metal oxides. Our study uncovers the role of surface charge doping on graphene devices, presenting new knowledge for engineering improved graphene spin current circuits.

References

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