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Direct Four-Probe Measurement of Grain-Boundary Resistivity and Mobility in Millimeter-Sized Graphene

Abstract

Grain boundaries (GBs) in polycrystalline graphene scatter charge carriers, which reduces carrier mobility and limits graphene applications in high-speed electronics. Here we report the extraction of the resistivity of GBs and the effect of GBs on carrier mobility by direct four-probe measurements on millimeter-sized graphene bicrystals grown by chemical vapor deposition (CVD). To extract the GB resistivity and carrier mobility from direct four-probe intragrain and intergrain measurements, an electronically equivalent extended 2D GB region is defined based on Ohm's law. Measurements on seven representative GBs find that the maximum resistivities are in the range of several kΩ·μm to more than 100 kΩ·μm. Furthermore, the mobility in these defective regions is reduced to 0.4−5.9 ‰ of the mobility of single-crystal, pristine graphene. Similarly, the effect of wrinkles on carrier transport can also be derived. The present approach provides a reliable way to directly probe charge-carrier scattering at GBs and can be further applied to evaluate the GB effect of other two-dimensional polycrystalline materials, such as transitionmetal dichalcogenides (TMDCs).

References

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Figures

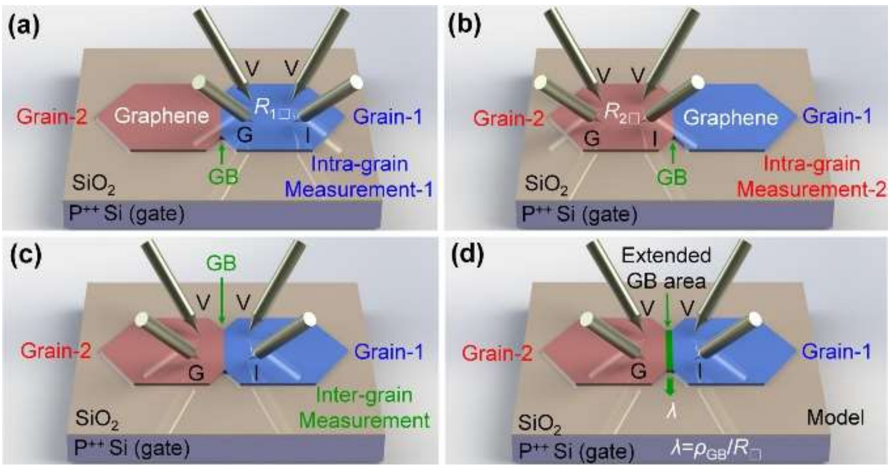

Figure 1: Schematic diagrams of four-probe measurements on graphene bicrystals.