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Electrical transport between single-crystal domains in graphene: bigger is not always better ADAM TSEN, LOLA BROWN, MARK LEVENDORF, Cornell University, FERESHTE GHAHARI, Columbia University, PINSHANE HUANG, CARLOS RUIZ-VARGAS, DAVID MULLER, Cornell University, PHILIP KIM, Columbia University, JIWOONG PARK, Cornell University — Single-layer graphene can now be produced on the centimeter or even meter scale using chemical vapor deposition. These large-scale graphene films are polycrystalline, consisting of many separate single-crystal domains, as was recently identified using transmission electron microscopy. Understanding the electrical transport across these domains is relevant not only for device applications, but has also been the focus of many fundamental studies. Here, we first examine the structure of graphenes produced under different growth conditions using dark-field transmission electron microscopy (DF-TEM). We find three classes of grain boundaries–continuous, amorphous, and overlapped. Next, we study the electrical properties of graphene devices consisting of individual grain boundaries that have been first imaged by DF-TEM. We find that the grain boundaries exhibit an additional gate-dependent resistance that is keenly sensitive to growth conditions. Surprisingly, this resistance is an order of magnitude greater for growths with larger grain size due to more poorly-connected domains. Our results show that domain size is not the single most important parameter determining electrical performance of large-scale graphene films–the quality of inter-domain connections is just as crucial.

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