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Imaging Grains and Grain Boundaries in Single-Layer CVD Graphene P.Y. HUANG, A.M. VAN DER ZANDE, C.S. RUIZ-VARGAS, W.S. WHITNEY, M.P. LEVENDORF, Y. ZHU, J. PARK, P.L. MCEUEN, D.A. MULLER, Cornell University — Single-layer graphene can be produced by chemical vapor deposition (CVD) on copper substrates on up to meter scales [1, 2], making their polycrystallinity [3,4] almost unavoidable. By combining aberration-corrected scanning transmission electron microscopy and dark-field transmission electron microscopy, we image graphene grains and grain boundaries across five orders of magnitude. Atomic-resolution images of graphene grain boundaries reveal that different grains stitch together predominantly via pentagon-heptagon pairs. We use diffraction-filtered imaging to map the shape and orientation of several hundred grains and boundaries. These images reveal an intricate patchwork of grains with structural details depending strongly on growth conditions. These imaging techniques will enable studies on the structure, properties, and control of graphene grains and grain boundaries.

[1] X. Li et al., Science 324, 1312 (2009).
[2] S. Bae et al., Nature Nanotechnol. 5, 574 (2010).
[3] J. M. Wofford, et al.,Nano Lett., (2010).
[4] P.Y. Huang et al., arXiv:1009.4714, (2010).

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