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Measuring the Strength of Single Crystal and Polycrystalline Graphene HAIDER RASOOL, UC Berkeley, COLIN OPHUS, Lawerence Berkeley National Laboratory, WILLIAM KLUG, UCLA, ALEX ZETTL, UC Berkeley, Lawerence Berkeley National Laboratory, JAMES GIMZEWSKI, UCLA — The mechanical properties of materials depend strongly on their crystallinity. In our work, we measure the yield strength of suspended single crystal and bicrystal graphene membranes fabricated from chemical vapor deposition grown graphene. Membranes are characterized structurally by transmission electron microscopy and mechanically tested using atomic force microscopy. A single crystal diamond tip with a large indentation radius is used to measure the intrinsic strength of suspended membranes for mechanical measurements. Single crystal membranes prepared by chemical vapor deposition retain strengths that are comparable to previous results of single crystal membranes prepared by mechanical exfoliation. Bicrystal grain boundary membranes with large mismatch angles have enhanced strengths when compared to their low angle counterparts. These boundaries show strengths that are comparable to single crystal graphene. To investigate this enhanced strength, we use aberration corrected high resolution transmission electron microscopy to map the atomic scale strain fields in suspended graphene. The enhanced strength of large angle bicrystal membranes is attributed to the presence of low atomic-scale strain at the boundaries.

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