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Atomic intercalation – a practical method to determine the nanoscale adhesion energy of graphene on HOPG[1] JUN WANG, Oak Ridge National Lab, DAN SORESCU, National Energy Technology Laboratory (NETL), U.S. Department of Energy, SEOKMIN JEON, ALEXEI BELIANINOV, SERGEI KALININ, ARTHUR BADDORF, PETRO MAKSYMOVYCH, Oak Ridge National Lab — A detailed analysis of atomic intercalates in graphite provides a direct estimate of the nanoscale elastic adhesion of a graphene sheet atop highly ordered pyrolytic graphite (HOPG). Atomic intercalation is carried out using conventional ion sputtering, creating "blisters" in the top-most layer of the HOPG surface. Scanning tunneling microscopy coupled with image analysis and density functional theory is used to reconstruct the atomic positions and the strain map within the deformed graphene sheet. To estimate the adhesion energy we invoke an analytical model originally devised for macroscopic deformations of graphene. This model yields a value of is $0.221 \pm 0.011 J/m^2$ for the adhesion energy of graphite, which is in surprisingly good agreement with reported experimental and theoretical values. This implies that mechanical properties of graphene scale at least to lengths of a few nanometers. The simplicity of our method enables analysis of elastic mechanical properties in many two-dimensional layered materials and provides a unique opportunity to investigate the local variability of mechanical properties on the nanoscale.

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