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Direct Measurement of Layer Adhesion in 2D Materials: Graphene on HOPG[1] ARTHUR P. BADDORF, JUN WANG, Oak Ridge National Laboratory, DAN C. SORESCU, National Energy Technology Laboratory, SEOKMIN JEON, ALEXEI BELIANINOV, SERGEI V. KALININ, PETRO MAKSYMOVYCH, Oak Ridge National Laboratory — The interest in mechanical properties of layered and 2D materials has reemerged in light of device concepts that take advantage of flexing, adhesion and friction. We report an experimental determination of the nanoscale adhesion of a graphene sheet on highly ordered pyrolytic graphite based on the effects of neon intercalation. Low energy ion implantation leads to local blisters in the top-most layer of the HOPG. Analysis of atomically resolved scanning tunneling microscopy images coupled with density functional theory is used to construct a strain map within the deformed graphene sheet. Adhesion energy is estimated using an analytical model originally devised for macroscopic deformations of graphene. This model yields an adhesion energy of 0.221 0.011 J/m^2, which is in excellent agreement with reported experimental and theoretical values. This implies that macroscopic mechanical properties of graphene scale down to a few nanometers length. The simplicity of this method enables analysis of elastic mechanical properties in 2D layered materials and enable investigation of the nanoscale variability of mechanical properties.

[1]Experiments were conducted at the Center for Nanophase Materials Sciences, which is a DOE Office of Science User Facility.

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