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Ultrastrong Adhesion of Graphene Membranes STEVEN P. KOENIG, NARASIMHA G. BODDETI, MARTIN L. DUNN, J. SCOTT BUNCH, Department of Mechanical Engineering, University of Colorado at Boulder — As mechanical structures enter the nanoscale regime, the influence of van der Waals forces increases. Graphene is attractive for nanomechanical systems because its Young's modulus and strength are both intrinsically high, but the mechanical behavior of graphene is also strongly influenced by the van der Waals force. For example, this force clamps graphene samples to substrates, and also holds together the individual graphene sheets in multilayer samples. Here we use a pressurized blister test to directly measure the adhesion energy of graphene sheets with a silicon oxide substrate. We find an adhesion energy of 0.45 +/- 0.02 J m-2 for monolayer graphene and 0.31 +/- 0.03 J m-2 for samples containing two to five graphene sheets. These values are larger than the adhesion energies measured in typical micromechanical structures and are comparable to solid–liquid adhesion energies. We attribute this to the extreme flexibility of graphene, which allows it to conform to the topography of even the smoothest substrates, thus making its interaction with the substrate more liquid-like than solid-like.

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