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Observation of Pull-in Instability in Graphene Membranes under Interfacial Forces XINGHUI LIU, NARASIMHA BODDETI, University of Colorado at Boulder, MARIAH SZPUNAR, University of Miami, LUDA WANG, University of Colorado at Boulder, MIGUEL RODRIGUEZ, Columbia University, RONG LONG, University of Alberta, JIANLIANG XIAO, University of Colorado at Boulder, MARTIN DUNN, Singapore University of Technology and Design, SCOTT BUNCH, Boston University, SCOTT BUNCH'S TEAM, MARTIN DUNN'S TEAM, JIANLIANG XIAO'S COLLABORATION — We present a unique experimental configuration that allows us to determine the interfacial forces on nearly parallel plates made from single and few layer graphene membranes. Our approach consists of using a pressure difference across a graphene membrane to bring the membrane to within $\sim$ 10-20 nm above a circular post covered with SiO_x or Au until a critical point is reached whereby the membrane snaps into adhesive contact with the post. Continuous measurements of the deforming membrane with an AFM coupled with a theoretical model allow us to deduce the magnitude of the interfacial forces between graphene and SiO_x and graphene and Au. The nature of the interfacial forces at $\sim$ 10 - 20 nm separations is consistent with an inverse fourth power distance dependence, implying that the interfacial forces are dominated by van der Waals interactions. Furthermore, the strength of the interactions is found to increase linearly with the number of graphene layers. The experimental approach can be applied to measure the strength of the interfacial forces for other emerging atomically thin two-dimensional materials.

Xinghui Liu
University of Colorado at Boulder

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