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The Structure of Suspended Graphene JANNIK MEYER, ANDRE GEIM, MIKHAIL KATSNELSON, KOSTYA NOVOSELOV, TIM BOOTH, SIEGMAR ROTH, University of Manchester — The recent discovery of graphene has sparked significant interest, which has so far been focused on the peculiar electronic structure of this material, in which charge carriers mimic massless relativistic particles. However, the structure of graphene is also puzzling. On one hand, graphene appears to be a strictly 2D material and exhibits such a high crystal quality that electrons can travel submicron distances without scattering. On the other hand, perfect 2D crystals cannot exist in the free state, according to both theory and experiment. This is often reconciled by the fact that all graphene structures studied so far were an integral part of larger 3D structures, either supported by a bulk substrate or embedded in a 3D matrix. We describe individual graphene sheets freely suspended on a microfabricated scaffold. These membranes are only one atom thick and still display a long-range crystalline order. However, our studies by transmission electron microscopy have revealed that suspended graphene sheets are not perfectly flat but exhibit intrinsic microscopic roughening such that the surface normal varies by several degrees and out-of-plane deformations reach 1 nm. The atomically-thin single-crystal membranes offer an ample scope for fundamental research and new technologies whereas the observed corrugations in the third dimension may shed light on subtle reasons behind the stability of 2D crystals.

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