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Cracking Large-Area Gragphene into Controlled Patterns XUANHE ZHAO, Duke University — Fracture of single atomic layers, especially graphene, has attracted increasing interests in physics and engineering over recent years. While existing studies are mainly focused on cases with individual cracks, fracture patterns in single atomic layers have been rarely explored. Here, we present a combined experimental and theoretical study on fracture and fragmentation of single-atomic-layer graphene on substrates. Our *in situ* observations show that deforming the substrates can crack large-area graphene films into patterns of long ribbons and rectangular fragments with controlled sizes. We use the shear-sliding theory to characterize the stress and deformation of graphene on substrates and carry out Monte Carlo simulations of the fragmentation process. The theoretical model matches consistently with experimental results. Our study further provides a simple method to obtain large amounts of data for statistical strengths of graphene and graphene-polymer interfaces. These properties are of fundamental importance to graphene-based materials and devices, yet extremely challenging to be measured with existing methods.

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