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Effect of Defects on the Intrinsic Strength and Stiffness of Graphene ARDAVAN ZANDIATASHBAR, Rensselaer Polytechnic Institute, GWAN HYOUNG LEE, Columbia University, HAMED PARVANEH, Rensselaer Polytechnic Institute, SUNG JOO AN, SUNWOO LEE, Columbia University, NITHIN MATHEW, CATALIN R. PICU, Rensselaer Polytechnic Institute, JAMES HONE, Columbia University, NIKHIL KORATKAR, Rensselaer Polytechnic Institute — Mechanical properties of defective mono-layer graphene sheets have been studied using experimental and computational tools. In experiments, elastic properties and breaking strength of free standing monolayer defective graphene membranes are measured by nanoindentation using an atomic force microscope. Defects have been introduced by exposure of membranes to oxygen plasma. Density of defects has been quantified using Raman and Auger electron spectroscopy, and also Transmission electron microscopy. Molecular dynamics simulations have been used to investigate the mechanical properties of free standing monolayer graphene membranes using reactive force fields. The effect of boundary conditions, as well as presence of defects in form of vacancies and bonded epoxide groups has been investigated and compared to experiments. Both experiments and simulations show decrease in Young's modulus and strength of graphene membranes by increasing defect density. However, the change in the elastic modulus is small below a certain defect density, which shows defective graphene membrane can still carry load and stay functional in different applications like decorated carbon based MOSFETs and graphene based nanocomposites.

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