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Generation of atomic scale defects in graphene by high-energy positive-ion bombardment DANIIL STOLYAROV, Brookhaven National Laboratory, ELENA STOLYAROVA, GEORGE FLYNN, Columbia University, KARL KUSCHE, IGOR PAVLISHIN, IGOR POGORELSKY, Brookhaven National Laboratory, PETER SHKOLNIKOV , Stony Brook University, VITALY YAKIMENKO, Brookhaven National Laboratory — We have demonstrated controllable defect generation in graphene (a single layer of a graphite crystal) and in few atomic layer thick graphitic films. Graphene flakes deposited on a silicon dioxide substrate by mechanical exfoliation were bombarded by a collimated high-energy (1 MeV) particle beam consisting of protons and positively charged ions. This beam was produced by Target Normal Sheath Acceleration (TNSA) upon irradiation of a metal foil with a terawatt CO2 laser pulse. Ions and protons with different mass and energy were separated by a permanent magnet installed between the laser target and the sample. After the exposure the graphene flakes were examined by Atomic Force Microscopy (AFM) and Scanning Tunneling Microscopy (STM). Irradiation of graphene films with both protons and positive ions results in the formation of atomic-scale defects without mesoscopic damage to the flake. The density of observed defects depends strongly on the number of atomic layers. This method can be used to modify single chemical bonds in graphene films and to engineer carbon based devices and sensors with tailored properties.

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