Creating nanoporous graphene with swift heavy ions

E. H. Åhlgren[1] A. A. Leino[1] A. V. Krasheninnikov[2] F. Djurabekova[1]
K. Nordlund[1] J. Kotakoski[3,1]

[1]University of Helsinki, Department of Physics, Helsinki, Finland
[2]Aalto University, Department of Applied Physics, Espoo, Finland
[3]University of Vienna, Department of Physics, Austria

Controllable modification of nanoscale materials can be achieved by irradiating the sample with energetic ions. Swift heavy ions (energy in the MeV range) on graphene have been studied only for a short time in a few experimental studies[1,2]. We present results on highly controllable defect production in suspended single layer graphene samples with swift heavy ions. The study comprises of an experimental ion irradiation study with Raman spectroscopy analysis, two-temperature molecular dynamics simulations including both the ionic and electronic subsystems, and density functional theory calculations of the specific electronic heat capacity for graphene with different charge states. The Raman mapping shows an increase in the defect size for increasing stopping power of the ion. This is also seen in the simulations, where the high energy irradiation creates cylindrical defects in the membrane. The diameter of the pores vary from few nm's up to hundreds of nm's. The dia meter of the defects can be controlled with the stopping power of the ion. Controllable modification of the atomic structure of graphene opens a way for patterning suspended samples for application purposes, such as creating porous graphene membranes for highly sensitive sensors and filters.

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