Spatial Analysis of Ion Beam induced Defects in Graphene

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Defects are expected to play a crucial role when preparing graphene for nanoscaled applications. Only recently the chemically inert graphene layer was found to form chemical bonds to an underlying metal support once vacancies are formed [1]. We employed the impact of noble gas ions on the graphene layer grown on Ir(111) to purposefully create defects. Ions impinging under an angle of 75° with respect to the surface normal are to a large extent able to penetrate the graphene layer and subsequently face scattering with the iridium surface. Depending on the primary energy (1 - 15 keV) and the ion species (He, Ne, Ar, Xe) manifold and complex reflection events take place on both faces between these layers. This leads to the formation of collision trails visible as surface damage in scanning tunneling microscopy. The resulting defect patterns can thus be spatially analysed. Annealing studies of these samples performed in-situ reveal these trails to origin from sputtering of the graphene layer and additional adatom production in the iridium crystal. While the metal surface mainly rebuilds its initial structure, the graphene layer forms rotational domains upon impact annealing. They result from agglomeration of rotated carbon bonds [2]. Besides giving an insight into their thermal stability this enables us to analyse these structures quantitatively and present models for the manifold defect patterns observed.

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