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Fundamental study of plasma-graphene interactions in Argon/B2H6 plasma

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Raman spectroscopy is an efficient method to characterize the graphene structure. The technique gives distinctive features for pristine, damaged and even doped graphene. Nonetheless, especially when graphene is grown on a polycrystalline substrate, strong discrepancies may appear on the macroscopic scale. Moreover, in the case of plasma irradiation of graphene, it is essential to understand the impact of the small heterogeneities in pristine graphene (local defects, grain boundaries, etc.) on the resulting graphene structure after treatment [1]. Hyperspectral Raman Imaging (RIMA for Raman Imaging) is a powerful method enabling the capture of qualitative as well as quantitative data on a macroscopic scale [2]. Grain Boundaries (GBs) reveal themselves being more resistant to plasma treatment than pristine graphene domains. After careful consideration of Raman parameters, it appears clearly that preferential self-healing of GBs and its surrounding is taking place, a phenomenon observed in 3D materials, yet to be observed in graphene. This mechanism is governed by carbon adatoms generated from impacts of low-energy argon ions with graphene film. Under constant irradiation from exited species (ions, metastable, VUV photons), carbon adatoms can easily migrate on graphene surface and, in particular, alongside GBs. Hence, defects created at GBs or present nearby might be healed by the adatoms influx [3]. Furthermore, another plasma conditions shown that energy fluence from Argon metastable deexcitation can be linked to an enhanced defect migration and self-healing at GBs [4]. Finally, the previous study in Argon plasma enable the determination of ideal operating conditions for Argon plasma with B2H6 trace. The exposition of graphene to such plasma reveals boron in-plane substitution combined with low-level hydrogenation and defect generation [5].

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