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Boron substitutional doping of graphene by low-pressure diborane-argon plasma

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Polycrystalline monolayer graphene films grown by chemical vapor deposition were exposed to a low-pressure inductively-coupled plasma operated in a gaseous mixture of argon and diborane. Optical emission spectroscopy and plasma sampling mass spectrometry reveal high B2H6 fragmentation leading to significant populations of both boron and hydrogen species in the gas phase. X-ray photoelectron spectroscopy indicates the formation of a boron-containing layer at the surface and provides evidence of a substitutional incorporation of boron atoms within the graphene lattice. To probe plasma's influence on graphene structure, Hyperspectral Raman Imaging (RIMA for Raman Imaging) is used to obtain qualitative as well as quantitative data on a macroscopic scale. Graphene domains doping by graphitic boration is then confirmed by hyperspectral Raman Imaging of graphene domains. These results demonstrate that diborane-containing low-pressure plasmas are an efficient mean for boron substitutional incorporation in graphene with minimal domain hydrogenation and defect generation.

Author: VINCHON, Pierre (Université de Montréal)

Co-authors: Dr GLAD, Xavier (Université de Montréal); Dr ROBERT-BIGRAS, Germain (Université de Montréal); Prof. MARTEL, Richard (Université de Montréal); Prof. STAFFORD , Luc (Université de Montréal)

Presenter: VINCHON, Pierre (Université de Montréal)

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