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(G*) N-Incorporation in Monolayer CVD Graphene by an Atmospheric Pressure ⊠⊠ Dielectric Barrier Discharge

Tuesday 20 June 2023 10:00 (15 minutes)

Nitrogen doped graphene, or N-graphene, is a promising material for a wide range of applications such as supercapacitors, optoelectronic devices, and biosensors. Nitrogen plasmas have been proved to be an excellent path to generate N-graphene from polycrystalline monolayer graphene films grown by chemical vapor deposition (CVD). In this study, CVD graphene has been exposed to low-frequency Townsend dielectric barrier discharge operated in nitrogen at atmospheric pressure. In such conditions, the discharge is weakly ionized, and the neutral gas temperature is close to 300 K. In addition, plasma-graphene interactions are dominated by plasma-generated N atoms and metastable N2(A) states, with the latter acting as a 6 eV energy reservoir. To investigate the mechanisms of nitrogen incorporation by the plasma-based process, Hyperspectral Raman IMAging (RIMA) and X-ray Photoelectron Spectroscopy (XPS) have been performed over different processing time. A clear defects generation is observed from the Raman signature with a transition towards amorphization for longer discharge exposure times. From the high spatial resolution of RIMA, different Raman dynamics can be seen at the grain domains (GD) versus at the boundaries (GB) of CVD graphene. It is found that there is a selective nitrogen incorporation at GDs, a feature linked to preferential healing of plasma-generated defects near GB. N-uptake is further discussed using the model proposed by Robert-Bigras et al. in which defects generation plays a critical role in the N-incorporation kinetics.

Keyword-1

Nitrogen Townsend Discharge

Keyword-2

Graphene

Keyword-3

Plasma-Graphene Interactions

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