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Title:

Pyridinic dominance nitrogen doped graphene by femtosecond pulsed laser deposition

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Abstract: (Your abstract must use **Normal style** and must fit in this box. Your abstract should be no longer than 300 words. The box will 'expand' over 2 pages as you add text/diagrams into it.)

Preparation of Your Abstract

1. The title should be as brief as possible but long enough to indicate clearly the nature of the study. Capitalise the first letter of the first word ONLY (place names excluded). No full stop at the end.

2. Abstracts should state briefly and clearly the purpose, methods, results and conclusions of the work.

Introduction: Clearly state the purpose of the abstract

Methods: Describe your selection of observations or experimental subjects clearly

Results: Present your results in a logical sequence in text, tables and illustrations

Discussion: Emphasize new and important aspects of the study and conclusions that are drawn from them

Carbon-based materials represent an attractive prospective in fuel cell, electrochemical and biosensors applications [1]. Recently, nitrogen doped carbon materials have raised attention in research and development to enhance their practical applications. Especially, the direct controllable nitrogen doping in graphene synthesis routes have been an attracting area of research in catalysis and sensor applications [2,3]. Here, we present the direct growth of N doped graphene from ultrashort-pulsed laser deposition technique, based on previous works related to direct synthesis of graphene [4]. The N doped graphene has been synthesized by femtosecond pulsed laser deposition and characterized by different characterization techniques to study microstructural, surface morphology and chemical bonding information. The Multi-wavelength Raman spectroscopy confirms the doping in graphene network. The nitrogen doping in graphene decreases the 2D band intensity and the correlation length. The Raman mapping has confirmed the homogenous doping of nitrogen in the graphene network. By doping, the G peak is blue shifted by 4 cm⁻¹ and the 2D peak is red shifted by 5 cm⁻¹; which corresponds to the n-type doping behaviour and could open a bandgap in the graphene. The surface morphology has been studied by Scanning Electron Microscopy (SEM) and Atomic Force Microscopy (AFM). The films shows the layered type structures and the low roughness values were estimated in both graphene and N doped graphene. The chemical composition and bonding have been studied by X-ray Photoelectron Spectroscopy (XPS), the nitrogen doping was estimated 3 at.%. The C1s spectra shifted to higher binding energy and the N1s spectra revealed three bonding structures, which are assigned to pyridinic-N, pyrrolic-N and graphitic-N type. The pyridinic-N dominance is high in our N doped graphene. The pyridinic-N dominance N doped graphene is attractive as a catalyst in Oxygen Reduction Reactions (ORR) to enhance their applications in fuel cells and electrochemical sensors. Compared to other carbon-based electrodes, N doped graphene will be a better electrode in electrochemical sensors. It can be used for the detection of hazardous pollutants and

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bio-pathogens at low concentrations.

References

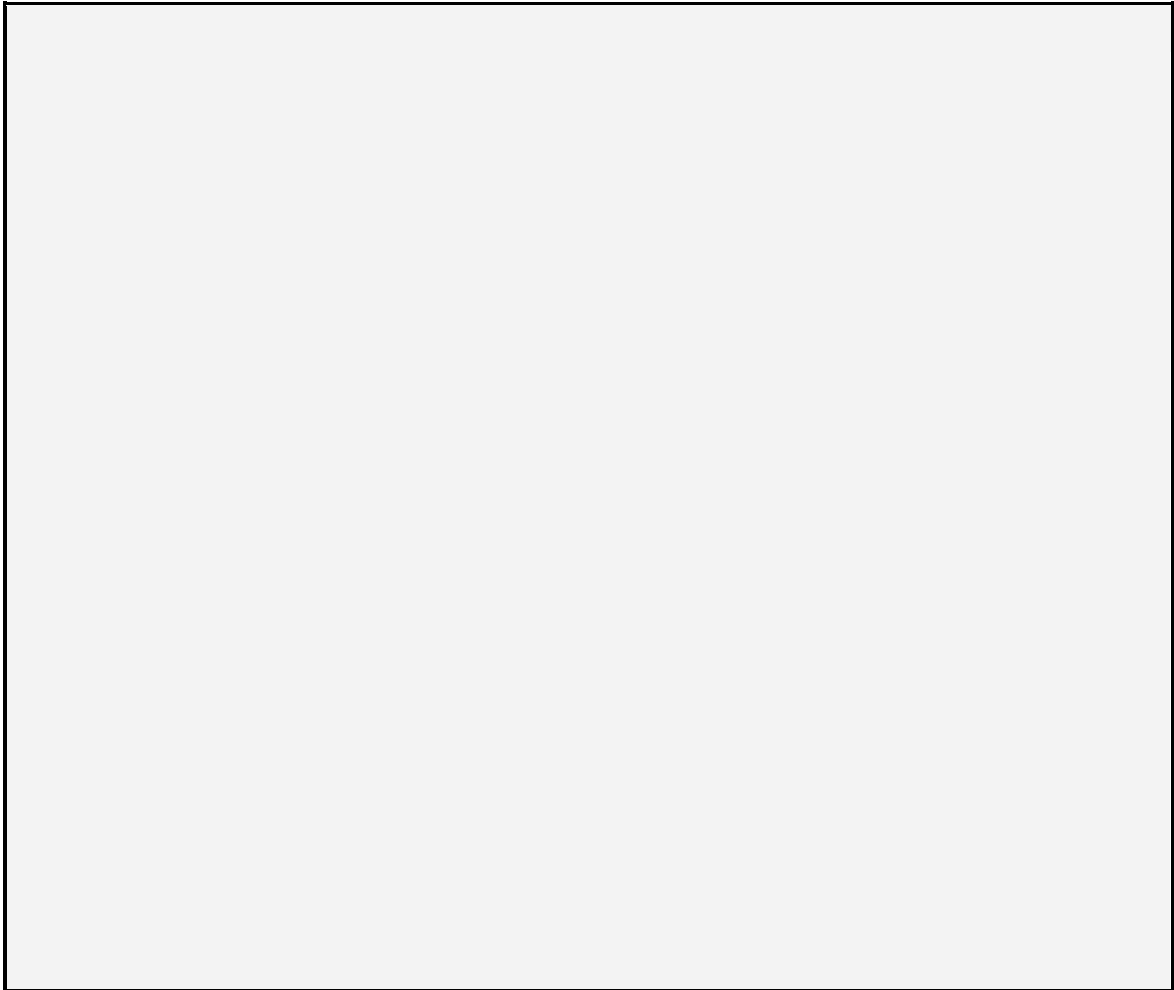
- (1) Fortgang, P.; Tite, T.; Barnier, V.; Zehani, N.; Maddi, C.; Lagarde, F.; Loir, A.-S.; Jaffrezic-Renault, N.; Donnet, C.; Garrelie, F.; *et al.* Robust Electrografting on Self-Organized 3D Graphene Electrodes. *ACS Appl. Mater. Interfaces* **2016**, *8*, 1424–1433.
- (2) Wu, J.; Ma, L.; Yadav, R. M.; Yang, Y.; Zhang, X.; Vajtai, R.; Lou, J.; Ajayan, P. M. Nitrogen-Doped Graphene with Pyridinic Dominance as a Highly Active and Stable Electrocatalyst for Oxygen Reduction. *ACS Appl. Mater. Interfaces* **2015**, *7*, 14763–14769.
- (3) Wang, Y.; Shao, Y.; Matson, D. W.; Li, J.; Lin, Y. Nitrogen-Doped Graphene and Its Application in Electrochemical Biosensing. *ACS Nano* **2010**, *4*, 1790–1798.
- (4) Tite, T.; Donnet, C.; Loir, A.-S.; Reynaud, S.; Michalon J.-Y.; Vocanson, F.; Garrelie, F.; Graphene-based textured surface by pulsed laser deposition as a robust platform for surface enhanced Raman scattering applications. *Applied Physics Letters* *104* (2014) 041912-1 – 0419012-4.

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