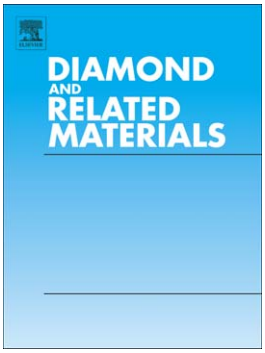

Raman spectroscopy and kelvin force probe microscopy characteristics of the CVD suspended graphene

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PII: S0925-9635(16)30008-5
DOI: doi: 10.1016/j.diamond.2016.01.008
Reference: DIAMAT 6550

To appear in: *Diamond & Related Materials*

Received date: 17 August 2015
Revised date: 7 January 2016
Accepted date: 8 January 2016

Please cite this article as: Krzysztof Gajewski, Stefan Goniszewski, Anna Szumska, Magdalena Moczała, Piotr Kunicki, John Gallop, Norbert Klein, Ling Hao, Teodor Gotszalk, Raman spectroscopy and kelvin force probe microscopy characteristics of the CVD suspended graphene, *Diamond & Related Materials* (2016), doi: 10.1016/j.diamond.2016.01.008

Raman Spectroscopy and Kelvin Force Probe Microscopy Characteristics of the CVD Suspended Graphene

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Abstract

In this work we present combined Kelvin probe force microscopy and Raman spectroscopy studies of supported and suspended structures formed out of chemical vapor deposition (CVD) grown graphene. Work function of both suspended and supported graphene was $-4.81 \pm 0.06eV$ and $-4.92 \pm 0.06eV$ respectively. By G and 2D modes correlation we showed, that CVD graphene was influenced by biaxial strain. Increased contact potential difference (CPD) on the suspended graphene in comparison with the areas of the supported graphene was the sign of increased strain (from 0.05% to $\sim 0.12\%$) rather than decreased doping (p-doping decreased from $\sim 5.5 \times 10^{12} cm^{-2}$ to $\sim 4.5 \times 10^{12} cm^{-2}$).

Keywords: Graphene, Suspended graphene, KPFM, Raman spectroscopy

1. Introduction

Graphene is considered to be one of the most promising materials for future advance in nanotechnology [1], [2]. This assumption stems from its high electrical and thermal conductivity, quantum hall effect, extraordinary stiffness [3], and mono-atomic thickness. The discovery of this sp^2 bonded carbon material has been a building block and inspiration for research of other 2D materials [4]. A broad spectrum of methods can be used for graphene production, including mechanical exfoliation, thermal sublimation from SiC and chemical vapor deposition (CVD) on transition metals [2]. Among the noted methods, the CVD growth on copper (Cu) foil is most promising when mass production is concerned enabling the production of square meters sheets of graphene. Graphene was employed in many prototypes including transistors, transparent electrodes, coatings, energy storage devices, but little study has been focused solely on graphene nanomechanical constructions and their characterization. Bunch et al. were the first to produce graphene doubly clamped beams and showed their resonant properties [5]. Bunch et al. have also carried out pioneering work on production of suspended graphene, mechanical resonance characterization, and bending of fabricated structures [6]. Later on, van der Zande et al. showed a method for production of beams array [7]. This work was continued by Barton et al. [8] and Shivaraman et al. [9]. It has to be noted that in the presented works mostly optical interferometry techniques were used for the structure characterization. Chen et al. were the first who used to use the frequency mixing techniques for electrical characterization of graphene beams [10].

The methods described above provided global information about the graphene structure properties. To the technologies enabling investigation of local (which means resolved with subnanometer resolution) system properties belongs scanning probe microscopy (SPM). One of the SPM technologies atomic force microscopy

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