eProceedings Chemistry 3 (2018) 29-30 || eISSN 2550-1453

Direct Growth of Graphene on Nickel Electrode at Low Temperature

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***Abstract*—Graphene has become attractive material because of its wide range of potential application. One of the concern to utilize this application is for industrial needs, which requires a large scale of high quality graphene directly on substrate without encounter any transfer process that will lead to device performance deterioration. Plasma Enhanced Chemical Vapor Deposition (PECVD) technique offered a good features in shortening the growth time and lowering the temperature therefore make this technique the most suitable approach. In this regard, we demonstrate a direct growth of graphene on Nickel electrode deposited on Si substrate. The characterization was carried out by 3D Optical Microscopy, Scanning Electron Microscopy, Raman Spectroscopy and Atomic Force Microscopy.**

Keywords—Graphene, Plasma Enhanced Chemical Vapor Deposition, Nickel electrode, Low Temperature

I. INTRODUCTION

Graphene is the most promising material in nanotechnology research because of its potential applications. Various synthesis processes with different substrates have been introduced to grow this attractive material. The production of single layer, bilayer and multilayer of graphene is strongly depending on a chemical condition during the process. These factors are very crucial to maintain and moreover to enhance its valuable properties. Chemical Vapor Deposition (CVD) is the technique that used in industry to synthesize large areas of high quality of graphene. However, Plasma Enhanced Chemical Vapor Deposition (PECVD) is more practical in shortening the process time and lowering the substrate temperature than those utilized in CVD reactors. Therefore, in this research, graphene sample on a SiO_2 (300 nm) wafer was prepared by the procedure known as the plasma enhanced chemical vapor deposition (PECVD) at growth temperature of 600 °C. Several papers have discovered various method to synthesized graphene sheet. Yi Zhang et al. (2013) [1] in his paper presented an important method for preparation and production of graphene on metal substrate such as Ni and Cu using a method of CVD as they believed that this method can produce a larger scale of graphene. However, this paper focus on the characterization of graphene on Nickel as a catalyst due to its carbon solubility [2].

II. METHODS

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A. *Methodology*

A direct growth of graphene on Nickel electrode at 600 °C was prepared by plasma enhanced chemical vapor deposition (PECVD). Radio frequency (RF) plasma, 40 W was applied during the growth process with 5 minutes deposition time.

B. *Characterizations*

The sample was characterized by 3D Optical Microscopy, Scanning Electron Microscopy, Raman Spectroscopy and Atomic Force Microscopy.

III. RESULTS AND DISCUSSION

A. *3D Optical Microscopy*

Fig. 1 shows the 3D optical image of patterning after etching process that carried out using HIROX 3D Optical Microscopy. It shows 21.2 µm depth and 0.584 µm surface roughness with etching time of 15 minutes using Deep RIE process.

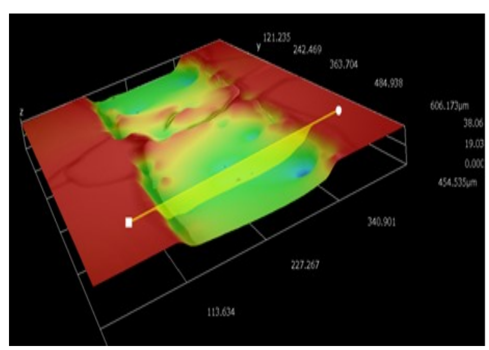

Fig. 1. 3D image of patterning electrode after etching process

B. Raman Spectroscopy

Fig. 2 shows a Raman spectra of the graphene sample with Nickel as a catalyst with the excitation wavelength of 514 nm. The spectra reveal a strong G band and D band at 1600 cm^{-1} and1360 cm^{-1}, respectively with a 2D band appeared at 2724 cm^{-1}. The relative intensity of bands G and 2D, (I_G/I_{2D}) discovered the sample was multilayer graphene.

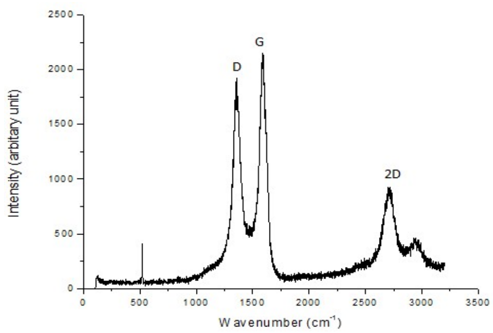

Fig. 2. . Raman spectra at 514 nm wavelength at particular area.

IV. CONCLUSIONS

In summary, we have demonstrated the direct growth of graphene by PECVD method at 600 °C. The relative intensity of 2D and G bands, (I_{2D}/I_G) shows the sample was multilayer graphene. These series of characterization will lead to our further discovery in order to lower the growth temperature without compromising the quality of graphene. We believe that the growth temperature can be reduced by further control in PECVD growth parameter and will expedite in sensor application.

REFERENCES

[1] Yi Zhang, Luyao Zhang, Chongwu Zhou, "Review of chemical vapor deposition of graphene and related applications", *Accounts of Chemical Research*, vol. 46, pp. 2329-2339, 2013.

[2] Wei Liu, Choong-Heui Chung, Cong-Qin Miao, Yan-Jie Wang, Bi-Yun Li, Ling-Yan Ruan, Ketan Patel, Young-Ju Park, Jason Woo, Ya-Hong Xie, "Chemical vapor deposition of large area few layer graphene on Si catalyzed with nickel films", *Thin Solid Films*, vol. 518, pp. 128-132, 2010.