

Novel Method for Hydroxylation of Graphene

Robin Singla

Anil Kottantharayil

Department of Electrical Engineering, Indian Institute of Technology Bombay, India

robin@ee.iitb.ac.in

Abstract

Functionalization of graphene is one of the ways to modify the electrical and chemical properties of graphene [1,2].

We show a novel method for functionalization of mono/multilayer CVD graphene by treating graphene on metal foil with hydrogen peroxide at different temperatures for different periods of time. XPS and Raman spectroscopy analysis shows hydroxyl functionalities distributed over the CVD graphene surface after functionalization. Relative peak area for C-OH increases from 11.99 % to 27.64 % and 22.53 % for CVD graphene treated with H₂O₂ at 60 °C for 30 minutes and 60 minutes respectively, as shown in table 1. Raman spectra shows increase in D peak intensity with increase in H₂O₂ treatment temperature and time. Increase in D peak intensity results in increase of I_D/I_G ratio which means conversion of sp² hybridization to sp³ hybridization which represents functionalization of CVD graphene. Heating of H₂O₂ results in dissociation of H₂O₂ into -OH radicals and Cu also acts as catalyst for this reaction. Heating of graphene in H₂O₂ results in damages of graphene also. UV light can also be used for dissociation of H₂O₂ which also results in functionalization graphene when graphene is treated with H₂O₂ in the presence of UV light and this is a non-destructive method. Hydroxyl functionalization of graphene helps in atomic layer deposition of Al₂O₃ on graphene, p-doping of graphene. Hydroxyl functionalized graphene can also be used as a sensor.

References

- [1] D. C. Elias, et al., Science 323 (5914) (2009) 610 - 613.
- [2] H. Liu, et al., Langmuir 25 (20) (2009) 12006 - 12010.

Tables

Band Position (eV)	Band Name	Pristine Graphene on Cu foil	After treatment at 30 °C for 60 min	After treatment at 60 °C for 30 min	After treatment at 60 °C for 60 min
284.4	C=C	85.46	78.67	60.3	50.03
285.3	C-OH	11.99	10.85	27.64	22.53
286.2	C-O-C	2.50	1.52	6.23	13.74
287.4	C=O	0	1.11	2.52	5.87
288.6	-O-C=O	0.05	7.85	3.31	4.83

Table 1: Relative peak area for each deconvoluted peak of C1s XPS spectra of CVD graphene on copper foil before and after treatment with H₂O₂ at 30 °C and 60 °C for different time periods.

Figures

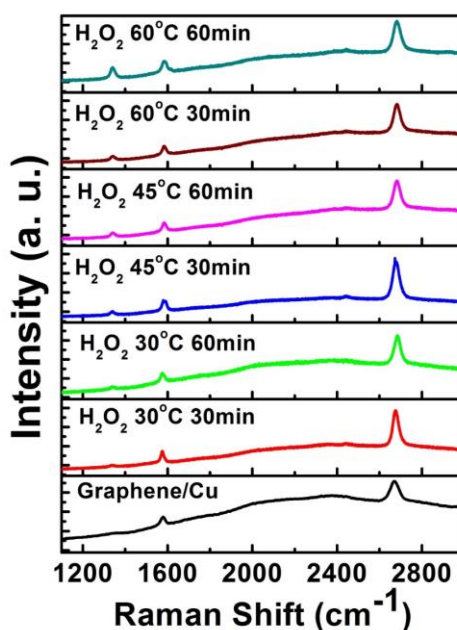


Figure 1: Raman spectra for CVD graphene on copper foil after treatment with H₂O₂ at different temperatures for different time periods.