

Low Temperature Growth of Graphene by Hot Wire Chemical Vapour Deposition

Shilpa Ramakrishna, Vivek Pandey, Rajeev O Dusane

Indian Institute of Technology Bombay, Powai, Mumbai, India
shilpark@iitb.ac.in

Abstract With the isolation of graphene in the year 2004 by A.K. Geim and K.S. Novoselov it has been explored to have vast scope in various applications as it exhibits exceptional electrical, mechanical, optical and thermal properties [1]. Till date, large area graphene of device quality has been grown by chemical vapor deposition successfully, however it is grown at very high temperatures around 800 °C -1000 °C by this technique [2]. There is a need for alternative synthesis route to obtain cost effective growth of graphene films for industrial scale production at low thermal budget. We have successfully grown for the first time, few layer graphene by hot wire chemical vapor deposition (HWCVD) at relatively low temperature around 500 °C – 600 °C on copper. Utilizing the decoupled nature of this deposition technique, wherein the dissociation of the precursor gas (methane and hydrogen) takes place away from the substrate and subsequent transportation of film forming species to the substrate enables the film growth at lower substrate temperature. We have characterized the as deposited films by Raman spectroscopy and transmission electron microscopy, which confirms the growth of few layer graphene. The film grown shows non uniformity across, the substrate surface (Cu) which could be due to surface morphology of Cu, as observed through scanning electron microscopy. Initially we have grown few layer graphene film grown at 500 °C with high defect density as analysed from the Raman spectrum, shown in figure 1, and the defect has been reduced further by controlling the process parameters namely precursor flow rate and chamber pressure as well as by engineering the copper surface.

References

- [1] K. Geim and K. S. Novoselov, Nature materials, **6** (2007) 183 – 191.
[2] X. Li, C. W. Magnuson, Venugopal, Archana, Tromp, M. Rudolf, Hannon, B. James, Vogel, Eric, Colombo, Luigi, Ruoff, Rodney S: 'Large- area graphene single crystals grown by low-pressure chemical vapour deposition of methane on copper', Nano Letters, 10 (2010) 4328–4334.

Figure 1: Raman Spectrum of graphene grown by HWCVD

