



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI  
SHORT ABSTRACT OF THESIS

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Programme of Study : Ph.D.

Thesis Title: Synthesis and Study of Different Carbon Nanomaterials: Diamond like carbon, Carbon Nanoflakes and Graphene Thin Films

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Thesis Submitted to the Department/ Center : Physics

Date of completion of Thesis Viva-Voce Exam : May 25, 2016

Key words for description of Thesis Work : Carbon Nanomaterials

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**SHORT ABSTRACT**

In this thesis, different structures of carbon allotropes: diamond like carbon, carbon nanoflakes and single & multi-layer graphene films are grown by hot filament chemical vapor deposition (CVD) method. These structures were grown with varying different deposition parameters such as substrate temperature, process pressure, CH<sub>4</sub> / H<sub>2</sub> gas flow rates, deposition time and filament to substrate distance. Graphene was also prepared by thermal reduction of graphene oxide at different annealing temperature under high vacuum (~10<sup>-5</sup> mbar). The fraction of reduction of oxygen containing functional groups is studied at different reduction temperature. To study the structural, optical (linear & non-linear) and electrical properties of above synthesized nanomaterials, films were characterized by X-ray diffraction, field emission scanning electron microscopy, atomic force microscopy, Raman spectroscopy, UV-Vis-NIR transmission spectroscopy, Fourier transform infrared spectroscopy, single beam closed aperture Z-scan technique and temperature dependent electrical conductivity using coplanar geometry. The formation of high nucleation density diamond nanoparticles (in the range of 80 – 120 nm) including flake type structure could be obtained at low substrate temperature (T<sub>s</sub>) of 450 °C and filament to substrate distance 1 cm. With the increase in separation between filament and substrate to 1.5 cm, only flake type structure is observed. Further, large area single layer graphene films on Ni substrate (~ in 100 μm dimension) could be obtained at low process pressure of 1 mbar and at T<sub>s</sub> of 700 °C followed by post annealing at higher temperature of 800 °C. It was observed that, post annealing is the most crucial parameters for the uniform growth of large area graphene films. Graphene films could also be successfully transferred on different substrates for fabricating the electronic devices. Graphene channel field effect transistor with the channel length of 60 μm has been fabricated and charge transport properties were studied.