INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

The present work aims towards the fabrication and characterization of diamond-like carbon (DLC) and graphitic thin films and few-/multi-layer graphene via pulsed laser deposition (PLD) technique. The structural characterization of all the films fabricated via PLD was performed by Raman spectrometer. The intensity of the excitation laser source while recording the Raman spectra of DLC films plays a crucial role in the correct measurement of film quality. It was observed that upto the laser intensity of 114 kW/cm^2, there was not much significant changes in the Raman spectra while above this, the spectra was drastically modified indicating the effect of focal heating and these changes in the film are of permanent nature. Thus, the Raman spectra reported in the entire thesis were recorded at a laser intensity of 114 kW/cm^2.The effect of deposition parameters; substrate temperature, laser fluence and the background helium gas pressure on the DLC film was undertaken in detail. It was observed that the low substrate temperature favoured the formation of carbon film dominated by sp^3 bonding while the film deposited at higher temperature, 700 °C and above, exhibited the graphitic nature. The variation in sp^3 fraction of the DLC thin film was more pronounced as a function of helium pressure as compared to that of laser fluence. The higher pressure of helium gas was observed to favour the structural ordering of graphitic thin films deposited at 750 °C. The linear optical properties of DLC and graphitic thin films were studied by spectroscopic ellipsometer and results were found to be in agreement with that of Raman studies. Graphene layers were also fabricated in oxygen ambient of 0.1 mbar and at laser fluence of 5.0 J/cm^2. The shape of 2D band of Raman spectra showed the signature of multilayer graphene at RT and few-layer graphene at the substrate temperature of 700 °C. Thus, the desired quality of the carbon based thin films devoid of hydrogen can be easily fabricated simply by selecting the appropriate deposition parameters in PLD technique. The π-bonds associated to sp^2 bonding in DLC and graphitic thin films possess the nonlinear optical behaviour. To study the optical nonlinearity in DLC and graphitic thin films, conventional *Z*-scan setup was modified by replacing the photodiode detector with the charge-coupled device camera. The modified setup offers the advantage of obtaining the open aperture and closed aperture *Z*-scan data in a single scan. DLC and graphitic thin films showed the positive nonlinearity. The NLR coefficient of carbon thin films was found to be increased with the sp^2 content.