



SYNTHESIS AND CHARACTERIZATION OF NITROGEN DOPED DIAMOND-LIKE CARBON THIN FILMS

Krishna C Kadiyala
M.S. Candidate

Faculty Advisor: Dr. E.I.Meletis / Dr. Raman

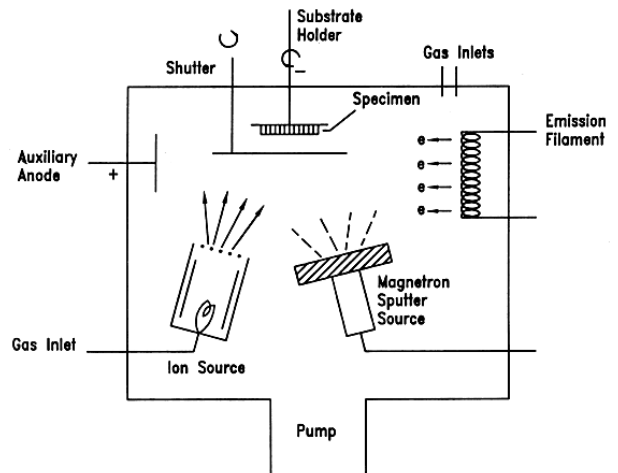
ABSTRACT

The highly attractive properties of Diamond like carbon thin films have been an interest to many researchers during the past decade, and being implemented in industry. In this process they have been trying to find new methods and processes to find better films such as Me-DLC or Doped DLC films which are claimed to be more efficient in almost all the properties of DLC films. Despite numerous efforts, there has been no agreed success in the synthesis of the predicted superhard crystalline phase C_3N_4 [1]. Nevertheless, there has been considerable effort to make amorphous carbon nitride ($a-CN_x$) films [2]. These are wear-resistant films, which are of interest, for example, for coating magnetic hard disks.

The drawbacks of DLC films such as high internal stress, poor adhesion and low thermal stability are improved with N-doping in DLC. In the present study we are going to discuss the synthesis, characterization, mechanical and tribological properties of Nitrogen doped DLC (N-DLC) thin films. DLC and N-DLC films are deposited on a Si substrate using dc plasma of known CH_4 and Ar gas mixture. A schematic of the deposition chamber is shown in the fig.

A careful study on DLC and N-DLC films were studied and some interesting results were obtained. Mechanical properties of the films were characterized by microhardness testing. The tribological properties were studied by conducting pin-on-disc experiments in the laboratory environment (Relative humidity 40-60%). Optical profilometry was used to analyze the wear profiles and the thickness/deposition rate of the samples deposited. A preliminary study was conducted utilizing various processing parameters (bias voltage, chamber pressure, Ar : CH_4 ratio) on DLC films to find out experimental conditions for Nitrogen doping in DLC films.

A DLC film with 90% Ar dilution, which had the lowest friction coefficient among a series of DLC films and performed better in wear and mechanical properties, was picked for the experimental conditions to deposit N-DLC films.



Schematic of the Deposition Chamber.

The N and Ar contents were varied keeping CH_4 constant at 20% for all the three N-DLC films. The Nitrogen content was found out to be best at 10%, with Ar at 70%, in mechanical and tribological properties. Super low friction Coefficients as low as 0.004 were observed in NDLC films, paving way for more research in various fields of interest. The conversion stage of $SP_3 \leftrightarrow SP_2$ hybridization of the films is found with C 1S peaks of various DLC and NDLC films found with XPS high resolution peaks of Carbon.

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