Thesis Title : **Study of Optical and Electrical Properties of Plasma Polymerized 1,2-Diaminocyclohexane Thin Films Synthesized by AC and RF Power Source**

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Abstract

Plasma polymerized (1,2-diaminocyclohexane) (PPDACH) thin films on to glass substrates has been prepared under AC and RF plasma condition using a capacitively coupled glow discharge reactor. Surface morphology of the PPDACH thin films, as observed by the FESEM micrographs, are smooth, homogenous and pinhole free. However, mosaic-like structure observed in the FESEM micrograph of AC plasma polymerized (PPDACH (AC)) thin films. AFM analysis confirmed that the surface roughness of RF plasma polymerized (PPDACH (RF)) thin films is smoother and more uniform than AC thin films. The at% of C and N in the PPDACH thin films are observed to increase with increasing film thickness. Structural characterization of monomer and plasma polymerized thin films were carried out by FTIR spectroscopic studies and it is observed that the plasma polymerization process modifies the structure of the polymer considerably from the monomer structure. Few new absorption peaks are found in polymer spectra, which are absent in the monomer spectrum. This is an indication of degradation or re-organization of the monomer molecules during the plasma polymerization. The films are amorphous in nature, which is confirmed by XRD analysis. The PPDACH (AC) film is thermally stable up to about 280 ^{o}C, whereas PPDACH (RF) thin film is stable up to about 165 °C, however the decomposition is delayed for the RF plasma thin films. From the UV-Vis spectra, it is clearly evident that the polymer films are optically transparent. The values of direct band gap are observed to increase with film thickness from 3.02 to 3.15 eV for the PPDACH (AC) thin films, while nearly equal (~ 3.47 eV) for the PPDACH (RF) thin films. On the other hand, the indirect band gaps vary from 1.79 – 1.93 eV and 1.87 – 2.10 eV with increasing film thickness respectively for the PPDACH (AC) and PPDACH (RF) thin films, respectively. Other optical parameters such as refractive index, extinction coefficient, Urbach energy, steepness parameter were also calculated for as-deposited PPDACH thin films to better understanding their optical properties. The dominant conduction mechanism in the PPDACH (AC) thin films is found Schottky type, whereas PPDACH (RF) thin films exhibited space charge limited conduction (SCLC) mechanism. The activation energies (ΔE) of the PPDACH (AC) thin films at the Ohmic region are found to be 0.15 – 0.19 eV and 0.27 – 0.30 eV for the lower and higher temperature region, respectively. However, for the and PPDACH (RF) thin films these values are 0.11 – 0.12 eV and 0.24 – 0.44 eV, respectively. In the non-Ohmic region, ΔE varies between 0.15 – 0.30 eV and 0.21 – 0.90 eV for the

PPDACH (AC) thin films and between 0.12 – 0.16 eV and 0.19 – 0.55 eV respectively at low and high temperature region.