PO3011

FTIR and visible optical characterization of SiCN:H thin films deposited in Ar/TMS/N2 dual ECR and RF-PVD plasmas

Mohammed BELMAHI[1], Ziad AL HALLAK[1], Robert HUGON[1], Thomas Easwarakhanthan[1], Philippe Pigeat[1], Ahmad Ahmad[2], Adnan NAJA[2], Laurent Thomas[3]

[1]Institut Jean Lamour CNRS Lorraine Univ., Nancy, France [2]LPM , Université Libanaise, Tripoli, Lebanon [3]Laboratoire PROMES, Univ. Perpignan, PERPIGNAN, France

mohammed.belmahi@univ-lorraine.fr

The particular optical and electronic properties of SiCN:H thin films make them useful for photovoltaic, optoelectronic and mechanical applications. Films properties depend strongly on their chemical composition and microstructure, and can be easily tuned through plasma process as well as gas mixture and composition. This work aims at modifying the physical properties of SiCN:H films by varying the Si content in the feed gases while keeping constant Ar, N2 and TMS (Tetra Methyl Silane). Films were grown on Si (100) floating or grounded substrates at a temperature of 400° C by dual ECR (2.45 GHz) and RF (13.56 MHz) PVD plasmas with silicon target, and variable RF biasing (Vbias). The plasma was characterized using optical emission spectroscopy (OES), and films were monitored in situ by visible reflectometry. They were analyzed ex-situ by SEM, FTIR, SIMS, and UV-Visible spectrometry. OES showed emission from Ar, Si, H□ lines and N2, CN, CH, NH rotational bands from the species in the plasma during the growth. Intensities of these excited states enhance with Vbias. IR optical index and film thickness were deduced using homemade software ASUVIR developed in MatLab from the measured transmittance with correcting its base-line. The film thickness thus found is in good agreement with SEM measurements. Moreover, this software allows a right estimation of film composition from FTIR spectra deconvolution. A sensible decrease of the CH2 line (2950 cm-1) and increase of NH (3350 cm-1) one with augmenting Vbias is obtained from FTIR spectra of thin films. For Vbias higher than 100 V it is possible to enrich the films with silicon. An increase of all density chemical bonds of SiC and decrease of SiN ones is observed when Vbias augments, indicating that the film composition varies from nitride to carbide-like films. However, the transparency of the films in the visible spectrum is decreased. This behavior could be corrected by hydrogen introduction in the feed gas. The SiCN:H obtained films appears very suitable for antireflective applications and Si-based PV. Moreover dual ECR –PVD plasma process appears very promising for high growth rate and homogeneous deposit on large scale substrates.

Keywords

Dual ECR-PVD plasmas

SiCN:H

FTIR