CHARACTERIZATION OF SiCN COATINGS DEPOSITED BY PECVD USING HEXAMETHYLDISILAZAN

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Silicon carbon nitrogen (SiCN) coatings are of interest to investigators owing to high hardness and good tribological and semiconductor properties. We report on an effect of RF discharge power (P_W) on the structural and mechanical properties of the coatings deposited by plasma enhanced chemical vapour deposition (PECVD) using hexamethyldisilazan (HMDSN) as the main precursor.

Amorphous SiCN coatings were deposited on silicon wafers. HMDSNS, vapored inside a thermostated bubbler, was delivered into a reaction chamber with hydrogen. Substrate temperature, working pressure and hydrogen flow rate were 350 ^{0}C, 0.2 Torr and 20 sccm, respectively. The coatings, deposited at various P_W: 5, 15, 30 and 60 W, were characterized by X-ray diffraction, Auger spectroscopy, atomic force microscope (AFM), Fourier transform infrared spectroscopy (FTIR). The hardness (H) and elastic modulus (E) were determined by means of nanoindentation.

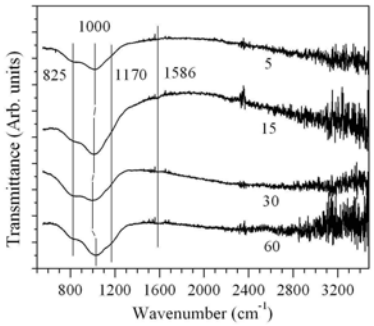


Fig 1. FTIR absorption spectra of the SiCN coatings deposited at various discharge power: 1-5W, 2-15W, 3-30 W, 4-60W

The structural, mechanical and tribological properties of the coatings were studied. The values of H and E were in the range of 17-22 GPa and 150-180 GPa, respectively. It was found that the improvement of the amorphous Si-C network (an increase of the absorption band at 800 cm^{-1} compared to the main Si-CH_n, Si-N and C-N bands around 1000 cm^{-1}) with increasing RF discharge power up to 30 W (cf. Fig.1) led to reducing the friction coefficient (cf. Fig. 2) and to increasing the resistance against abrasive wear (cf. Fig. 3). The adhesion of the coatings to the substrates was enhanced with P_W (cf. Fig.2).

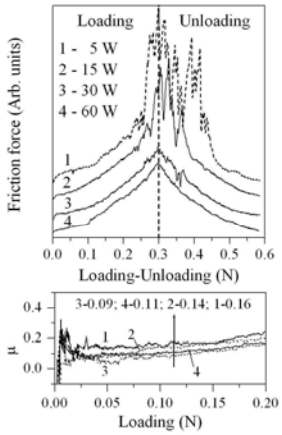
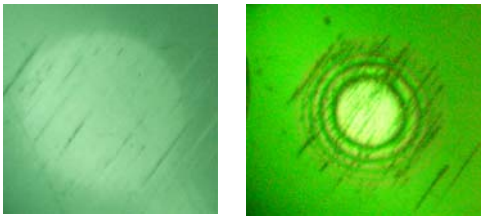


Fig 2 Friction force and friction coefficient μ of the coatings as functions of loading and unloading



(a) **(b)**

Fig 3. Photos of the crates after the calowear tests (a –Si substrate, b – SiCN coating deposited at 60 W). It is seen that the crater on the coating is less then on the substrate, which indicates higher wear resistance of the coatings compared to that of silicon substrates on average 4 times

These investigations showed that the PECVD SiCN coatings with the best mechanical and tribological properties can be prepared at an optimum discharge power ~ 30 W.

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