

Influence of Temperature on Etch rate of PECVD-SiN_x films with CF₄/H₂ plasma

S. N. Hsiao¹, K. Nakane¹, T. Tsutsumi¹, K. Ishikawa¹, M. Sekine¹, and M. Hori¹

Center for Low-temperature Plasma Sciences, Nagoya University¹

E-mail: hsiao@plasma.engg.nagoya-u.ac.jp

The dependences of substrate temperature (from 50 to -20 °C) on etch rate in two series PECVD SiN films (A and B) with a CF₄/H₂ mixture plasma were investigated. Thin film characterization including Fourier transformation infrared spectroscopy (FTIR), X-ray reflectivity (XRR), and x-ray photoemission (XPS) of the PECVD SiN films were also conducted to understand the properties of the films. The XRR and XPS indicated that the chemical composition and film density were almost identical. The FTIR shows that the N-H groups were much greater in the A samples than that of B samples. On the contrary, larger fraction in Si-H were found in B samples. The films with greater N-H bonds have a lower etch rate at low temperature (-20 °C) than observed at room temperature and higher; contrarily, the films with a greater Si-H content have a higher etch rate at lower temperature, as illustrated in Fig. 1. It was found that the CF_x thickness was thicker in the B samples than A samples, suggesting that hydrogen originated from the broken Si-H bond which leads to a polymerization. In addition, a thinner CF_x was found in the B samples at low temperature, as a result of higher etch rate. When changing the self-bias voltage, we found that N-H bonding forms easier at low temperature than room temperature. We suggest that the bonding structure of the films and substrate temperature can influence CF_x film, fluorine reaction probability and H dissociation in the etching process, which leads to an overall variation of the etch rate.

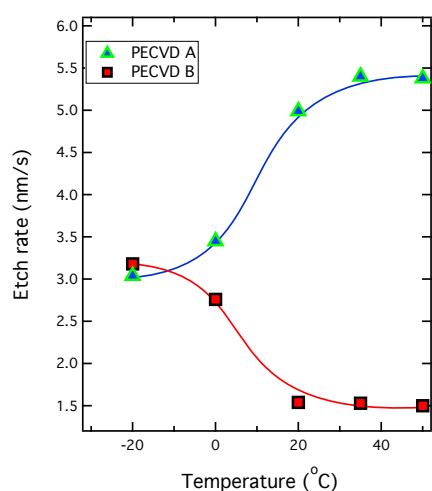


Fig. 1 Etch rate as a function substrate temperature in two series of PECVD films.