

고 에너지 이온빔에 의한
PECVD 질화규소막 내의 수소 이탈현상에 관한 연구
 (A Study on the Hydrogen Loss for PECVD Silicon Nitride Films
 during High Energy Ion Beam Irradiation)

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The PECVD silicon nitride films are referred to as a hydrogenated amorphous silicon nitride ($a\text{-Si}_x\text{N}_y\text{H}_z$). Determination of atomic and bond density measurement by Rutherford backscattering (RBS) technique and the bond structure analysis by infrared (IR) absorption spectrum is known to be a useful method for characterizing the PECVD silicon nitride films. Especially, both energy recoil detection (ERD) and nuclear reaction analysis (NRA) techniques are open used to quantifying the hydrogen atoms in the film that is difficult to analyze by most traditional analytical methods. The number of hydrogen atoms in the films obtained by above MeV ion beam techniques can be used for calibrating absorption cross-sections of the hydrogen related bond in the IR spectrum.

Recently, the radiation damage, particularly the hydrogen loss during irradiation of high energy ion beam, has been discovered for the hydrogenated silicon nitride film. This undesirable loss of the hydrogen count during ERD measurement can cause serious experimental error in the hydrogen content for the film.

The objective of this paper is to investigate the radiation damage effect during 2.5 MeV $^4\text{He}^{++}$ ERD analysis by the study of chemical bonds in the PECVD silicon nitride film using Fourier transform infrared (FTIR) spectroscopy.

Figure 1 shows accumulated ERD counts for the PECVD film against the dose of 2.5 MeV He^{++} ion beam. The films deposited at 200 and 300 °C show significant decrease in the ERD count with the ion beam dose. This result indicates that the hydrogen atom diffused out of the film due to the ion beam irradiation damage. On the other hand, the film deposited at 400 °C shows no significant changes in the ERD count. Thus, the hydrogen loss effect influenced more dramatically for the films deposited at low substrate temperatures. Detailed results concerning the hydrogen related bonds, such as Si-H, N-H and Si-N, measured by FTIR will be discussed.

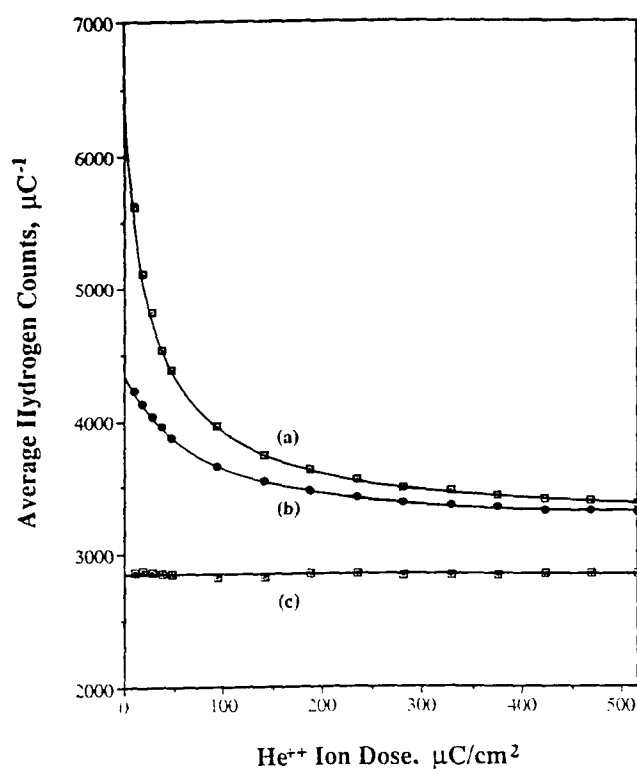


Fig. 1. Effect of 2.5 MeV He^{++} ion beam irradiation on ERD hydrogen counts for the PECVD silicon nitride films deposited at (a) 200 °C, (b) 300 °C and (c) 400 °C using $\text{SiH}_4 + \text{NH}_3 + \text{N}_2$ gas mixture. The film thicknesses are (a) 2511, (b) 2118 and (c) 1740 Å, respectively.