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Intial oxynitridation and nitridation of silicon surfaces by NO and NH_3 decomposition

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In recent days, there are great technological interests on the fabrication and understanding of well-defined ultrathin oxynitride and nitride films on silicon substrates. In the present talk, we will review our recent research activity on the very initial stages of nitridation and oxynitridation of silicon surfaces, mainly focusing the intial adsorption and decomposition of nitric oxide (NO) and ammonia (NH_3) on Si(100) and Si(111) surfaces. The adsorption and reaction of such N-containing molecules were investigated by high-resolution photoemission spectroscopy using undulator synchrotron radiation (BL 8A1 of Pohang Light Source).

Our recent photoemission results clearly identify the bonding congurations of different (molecular or atomic) N-species adsorbed dissociatively with different number of N-Si bonds at various substrate temperatures of 100 - 1000 K. The adsorption of NH_3 on Si(100) produces a series of Si-NH_2, Si=NH, and Si≡N species showing a successive N-H bond cracking during thermal decomposition [1]. On the other hand, the NO molecules adsorb on Si(100) dissociatively to form Si≡N and Si=O species even from 150 K [2, 3]. In addition, the metastable adsorption species of N=Si_2 are observed only at 150 K [2]. The fully-coordinated Si≡N species are easily incorporated into the subsurface Si layers to form a N-rich layer [4]. These results suggest some insight into the decomposition and N-incorporation mechanism involved in the initial nitride and oxynitride formation. We finally discuss the interfacial structures of oxynitride and nitride films on Si(100) [5] and Si(111) [6], respectively as proved by high-resolution Si 2p core-level photoemission.

[참고문헌]

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