Behavior of the well-ordered 6H-SiC(000$\bar{1}$) surfaces in the atmosphere

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Introduction

Silicon carbide (SiC) is an expected semiconductor, which has a good physical properties to make the high-temperature, high-speed and high-power electronic devices. The performance of these devices strongly depends on the surface characteristics of this crystal. So we have to know the surface behavior of this crystal in the atmosphere to produce reliable devices.

Experimental

Samples were n-type 6H-SiC single crystal wafers with the carrier concentration of $2x10^{18}cm^{-3}$. After chemical treatments, the 6H-SiC(000$\bar{1}$) 1x1 surface (sample A) and 3x3 reconstructed surface (sample B) were obtained by resistive heating of wafers in the ultra high vacuum (UHV), respectively. These structures were confirmed by LEED pattern. After samples were exposed to the atmosphere, photoemission spectroscopy measurements for these surfaces in the UHV were carried out at the beam line BL25SU of the SPring-8. This beam line is equipped with a SES200 spherical mirror analyzer. The photoelectrons were accepted with the angle θ =10° to the sample surface normal.

Results and discussion

C1s spectra for sample A and B surfaces are shown in Fig.1 where the binding energy is referred to that of bulk SiC C1s. The signal at higher binding energy by about 1.5eV of sample A should originate from the contaminant C layers that were dominated by graphite bond.[1,2] On the other hand, the signal at higher binding energy by about 1.8eV of sample B should originate from contaminant C layers that were dominated by C-H and C-C bonds.[3] This fact indicates that the contaminant layer on the surface depends on the structure of the surface. By comparing the magnitude of signals between the contaminant C and bulk C, it is deduced that the contamination of the sample A is larger than that of the sample B. There was the report that the 3x3 surface with contaminant free was originated from the carbon layers on top of a bulk truncated crystal. The C1s binding energy of the carbon layers is reported to shift 2eV to higher binding energy compared to the bulk SiC.[2] This suggests that the signal at higher binding energy of the sample B would contain the contribution from the surface before being exposed to the atmosphere. Therefore, the well-ordered 6H-SiC(000$\bar{1}$) 3x3 surface is expected to be almost free from the contamination of adsorbed carbon by the exposure to air.

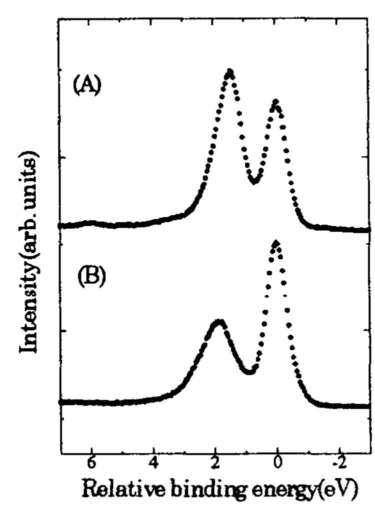

Fig.1 C1s Spectra of the 6H-SiC(000$\bar{1}$) surfaces exposed to the atmosphere. Incident photon energy is 660 eV. (A)1x1 surface and (B)3x3 surface.

Reference

1) L. Muehlhoff et al., J.Appl.Phys. 60(1986)2842
2) L.I. Johansson et al., Surf. Sci. 405(1998)288
3) H.Tsuchida et al., Jpn.J.Appl.Phys. 34(1995)6003