19B/2002G194

Electronic Structure of Cr/6H-SiC Interface by SX FS

Masaaki HIRAI*[1], Chihiro KAMEZAWA[2], Selgei AZATYAN [2,] Takashi SHINAGAWA[2], Tomoya FUJISAWA[2], Masahiko KUSAKA[1] and Motohiro IWAMI[1]
[1]Research Laboratory for Surface Science, Faculty of Science,
[2]Graduate School of Natural Science and Technology,
Okayama University, Okayama 700-8530, Japan

Introduction

Silicon carbide (SiC) is one of candidate materials in hard electronics such as high-power, high-frequency, high-temperature and high-radiation field because of high saturation electron velocity and high breakdown electric field compared with silicon (Si). For the application of electronic devices it is necessary that the physical properties of metal-SiC contact system are clarified.
In this report the partial density of states for Cr/6H-SiC(0001) Si-face contact system is studied by soft X-ray florescence spectroscopy (SXFS).

Experimental

The samples were prepared as follows.
(i) A wafer of 6H-SiC(0001) Si-face was cleaned by being rinsed in ethyl alcohol, dipped in 5% HF solution and flashed under ultra-high vacuum (UHV) condition.
(ii)Cr metal was evaporated on the surface of this substrate by heating of tungsten boat with Cr plates.
(iii)The sample of Cr/6H-SiC(0001) contact system was thermally treated with electric furnace in flowing H_2+N_2 gases at 750 ºC~950 ºC for 30 minuets.

The film thickness of evaporated Cr was about 50nm. The soft X-ray florescence spectroscopy (SXFS) was studied by using a beamline of BL-19B at the SR facility of Photon Factory in KEK. The Si $L_{2,3}$ and C *1s* SXF spectra of the sample were obtained using photon energy of 145eV and 350eV, respectively and recorded by grating monochromator with a curvature of 5m and position sensitive detector. This SXFS is characterized considering partial density of states in the total energy states due to dipole selection rule of electron transitions.

Results and Discussion

A shape and peak energies of the Si $L_{2,3}$ florescence spectra obtained from (a) thermal-treated specimen in 750ºC for Cr/6H-SiC(0001) Si-face contact system were compared with reference ones obtained from specimens of (b) a pressed powder of Cr_3Si, (c) a pressed powder of $CrSi_2$ and (d) a 6H-SiC(0001) Si-face. The spectrum of (d) is characterized by a hump of 86.5eV, a main peak of 91.7eV, plateau region from 93eV to 99eV and a peak at 98.7eV. The spectrum of (a) is characterized by two peaks of ~91eV and ~96eV. The spectrum of (b) has three peaks at ~90.6, ~96 and ~99.5eV. The spectrum of (c) has two peaks at ~92eV and ~98eV. The spectrum of (a) has the similar characteristics of two peaks as (b) except for ~99.5eV, but intensity ratio of two peaks is different and peak energies are also slightly different. Also, the spectrum of (a) is a few different from one of (c) for peak energies. However, the spectrum of (a) is entirely different from one of (d) for spectrum shape and peak energies. Therefore, it is considered that the product of thin film on 6H-SiC mainly contains the Cr_3Si and other materials e.g., ternary compound.

A shape and peak energies of the C *1s* florescence spectra obtained from (e) thermal-treated specimen in 750°C for Cr/6H-SiC(0001) Si-face contact system were compared with reference ones obtained from specimens of (f) a pressed powder of Cr_3C_2, (g) a 6H-SiC(0001) Si-face and (h) a graphite plate. The spectrum of (e) is characterized by a main peak at 283eV, a small peak at 266eV and a shoulder at 277eV. The spectrum of (f) has a single peak at ~282eV. The spectrum of (g) has a main peak at ~282eV and a shoulder around 276eV. The spectrum of (h) has a single peak at 278eV. Therefore, it is concluded from a comparison with characteristics of these spectra that C *1s* SXF signals indicated possible formation of carbides and/or graphite.

Summary

These results are summarized as follows. The interface reacted region is composed of Cr-Si compound; silicide and cabide with graphite-like C and other carbon compound.

hirai@science.okayama-u.ac.jp