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SiCターゲットのRF-UBMS法を用いたSiC膜の形成
Silicon Carbide Film Prepared by Unbalanced Magnetron Sputtering with SiC Target

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1. Introduction

Silicon Carbide (SiC) film has excellent properties such as high hardness, heat resistance, and abrasion resistance [1]. Therefore, SiC films have been widely used for microelectronic devices or protective coatings on steel [2]. SiC films can be prepared by chemical vapor deposition (CVD) and physical vapor deposition (PVD). The CVD-SiC film inevitably contains hydrogen, which causes softening. On the other hand, the sputtering method, which is one of the PVD methods, does not require hydrogen and has good adhesion. In this study, silicon carbide films were formed by the RF-Unbalanced Magnetron Sputtering (RF-UBMS) method.

2. Experimental methods

Silicon Carbite films were formed on Si substrates by the RF-UBMS method in Ar atmosphere. The sputtering target was SiC plate (ϕ46 mm, t3 mm). The distance between the SiC target and the substrates was 90 mm. The RF (13.56 MHz) power was 500 W. The base pressure was 5.0×10^{-4} Pa. The different DC substrate-bias voltages and the different process pressures were applied. The prepared films were analysed with various diagnostics and compared. The molecular structure of the films was identified by Raman spectrometer with a laser wavelength of 532 nm. The crystallinity of the films was analysed X-ray diffractometer (XRD). The composition ratio of the film was analysed by X-ray photoelectron spectrometer (XPS).

3. Results and discussion

Figure 1 shows XRD spectra of prepared films at various bias voltages. The prepared film showed a broad peak at 34° with poorly crystalline SiC. The peak at 42° is derived from alumina of divergence slit. The SiC peak was shifted to the low wavenumber side by applying bias voltage. In addition, the peak intensity decreased.

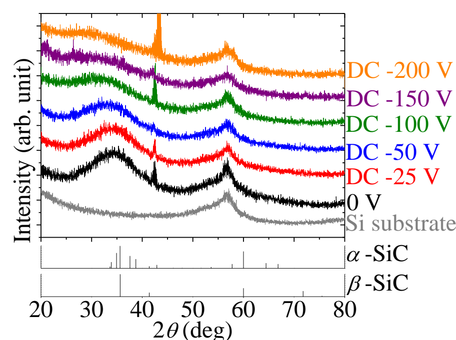

Fig. 1 XRD spectra of prepared films at various bias voltages.

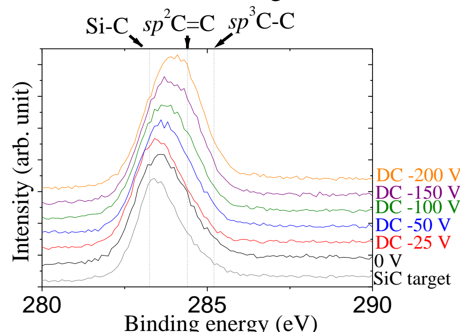

Fig.2 XPS spectra of C1s at various bias voltages.

Figure 2 shows XPS spectra of prepared films at various bias voltages. The C1s spectra can be discomposed into three peaks: 283.3 eV(Si-C), 284.4 eV(sp^2 C=C), 285.2 eV(sp^3 C-C). In the prepared films, Si-C bonds were reduced and carbon bonds were increased compared to the SiC target. The C / Si ratio changed from 1.2 to 2.1 by applying bias voltage. We will report some properties of SiC films fabricated under the various DC substrate-bias voltages and the various process pressures.

References

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