§21. Surface Compositional Changes of Bulk-Boronized Graphite under Argon Ion Bombardment

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Recently, compound materials of carbon, such as B_4C and SiC, are employed as one of the plasma-facing components in fusion devices because of some advantages, for example: low atomic numbers, high heat resistance and high durability for chemical erosion [1-4]. It is expected that the surface composition of compound materials is changed under plasma particle bombardment, because of preferential sputtering induced by the difference in the surface binding energies and the atomic masses. It is important to know how to change the surface composition of compound materials. However, there are a few reports about the surface compositional changes [5].

In this investigation, ion beams were used in order to sputter targets. The present vacuum system consists of two chambers; the beam chamber and the analysis chamber [6]. The beam chamber is pumped down to 1×10^{-10} Torr with a turbo molecular pump with a liquid nitrogen trap, the analysis chamber is meanwhile pumped out with an ion-pump and a titanium-sublimation-pump surrounded by a liquid nitrogen cold trap. The background pressure in the analysis chamber is about 5×10^{-11} Torr without targets and about 1×10^{-10} Torr with targets. A target is put on an XYZR-manipulator fixed on the beam chamber and can be brought down into the analysis camber thorough a gate-valve. As targets, the 30% bulk-boronized graphite (Toyo Tanso GB-130) was used.

The target surfaces are sputtered by argon ions using an ion gun located in the beam chamber. Using the raster mode of this ion gun, it is possible to sputter the target surfaces, uniformly, in the area of about 4 mm in diameter. The ion beam currents on the target are measured with a digital pico-ampere meter and then fed to a personal computer (usually about 24 μ A/cm^2 with 3 keV argon ions). After the targets are sputtered in the beam chamber, they are brought down into the analysis chamber. Then, the surface condition is measured by an Auger-electron-spectrometer (AES) in the analysis chamber. The surface composition ratios were measured for four different points in the same irradiated area. All present experiments have been performed at room temperature.

In fig.1, the present experimental results for 3 keV argon ions (about 1.5×10^{14} cm^{-2}sec^{-1}.) are shown. The solid circles and open squares correspond to measured concentrations of boron and carbon, respectively. In all present measurements, any peaks of the Auger electrons have not been observed, except for boron and carbon. It is found that concentrations of boron increase as the incident ion fluence increases and approaching a constant value that is about 40%.

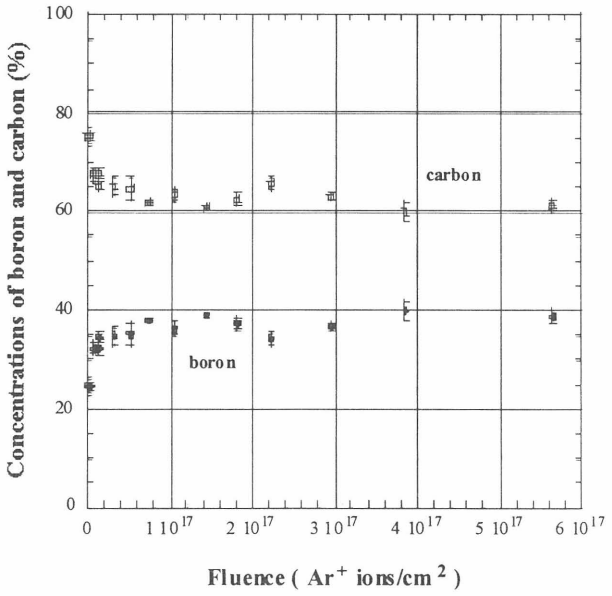

Figure 1
The projectile-fluence dependence of concentrations of boron and carbon induced by 3 keV argon ion bombardment on the 30% bulk-boronized graphite surfaces.

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