 Study on retention behavior and chemical states of energetic deuterium implanted into carbon-contained boron film

Y. Kikuchi\textsuperscript{a}, Y. Yang\textsuperscript{b}, A. Yoshikawa\textsuperscript{a}, T. Suda\textsuperscript{a}, H. Miyauchi\textsuperscript{a}, T. Nakahata\textsuperscript{a}, A. Sagara\textsuperscript{c}, N. Noda\textsuperscript{d}, Y. Oya\textsuperscript{a} and K. Okuno\textsuperscript{a}

\textsuperscript{a}Radiochemistry Research Laboratory, Faculty of Science, Shizuoka University, 836, Ohya, Suruga-ku, 422-8529 Shizuoka, Japan
\textsuperscript{b}Institute of Plasma Physics, Chinese Academy of Sciences, Hefei, 230031 Anhui, China
\textsuperscript{c}Fusion Engineering Research Center, National Institute for Fusion Science, Oroshi 322-6, Toki, 502-5292 Gifu, Japan
\textsuperscript{d}National Institute for Fusion Science, 322-6 Oroshi-cho, Toki-shi, 509-5292 Gifu, Japan
r0732007@ipc.shizuoka.ac.jp

In magnetically confined plasma experimental devices, boronization has been applied as one of the most effective first wall-conditioning techniques. For the next step devices, boronization is considered to be helpful for the improvement of startup and confinement. It is thought that impurities such as carbon and oxygen would be contained in the boron film on the first wall. From the viewpoint of fusion safety, it is helpful to reveal the retention and trapping states of tritium in carbon and/or oxygen-contained boron films. In the present study, chemical behavior of deuterium implanted into carbon-contained boron film was investigated.

Carbon-contained boron films with carbon atomic concentration of 35\% were prepared as the samples by means of Plasma Chemical Vapor Deposition. The deuterium ions (D\textsuperscript{2+}) with an ion energy of 1 keV, ion flux of 1.0\times10\textsuperscript{18} D\textsuperscript{+} m\textsuperscript{-2} s\textsuperscript{-1}, and ion fluence of 7.3\times10\textsuperscript{21} D\textsuperscript{+} m\textsuperscript{-2} were implanted into the sample with various implantation temperatures between 323 K and 823 K. After D\textsuperscript{2+} implantation, deuterium retention behavior and trapping states in the samples were investigated by Thermal Desorption Spectroscopy (TDS) and X-ray Photoelectron Spectroscopy (XPS).

From the results of D\textsubscript{2} TDS for the samples implanted with D\textsuperscript{2+} implantation at 323 K, the spectrum could be separated into three peaks at 520, 700 and 900 K with the Gaussian distribution. From the comparison with the spectrum for the pure boron film, it was concluded that the peak temperatures at 520 K and 700 K could be attributed to B-D-B and B-D bonds, respectively, and the peak temperature at 900 K could be C-D bond. Deuterium retention trapped by B-D-B and B-D bonds decreased with the increase of the implantation temperature. On the other hand, the D retention trapped by C-D bond showed different tendency. It didn’t decrease with the implantation temperature less than 673 K, while it decreased rapidly with the implantation temperature above 673 K. These facts indicate that the process of C-D bond forming was different from that of B-D-B and B-D bonds. In the presentation, detailed discussion will be given by comparison with the experimental results for pure boron film.