Solubility of Tritium in Cu-Be Alloy

M. Matsuyama[a], K. Shinmura[a], Z. Chen[b], and Y. Torikai[a]

[a)] *Hydrogen Isotope Research Center, University of Toyama, Gofuku 3190, Toyama 930-8555, Japan*

[b)] *School of Nuclear Science and Technology, University of Science and Technology of China Hefei, Anhui Province 230026, P. R. China*

Although stainless steels are widely used for construction of a tritium handling system, adsorption and/or dissolution of tritium is inevitable. This is more severe problem for high-level tritium handling system such as ITER from view points of tritium safety and waste management. Therefore, it is of a great importance to reduce the adsorption amount on the surface and/or absorption amount in bulk for various materials. It is well known that copper is one of low solubility materials for hydrogen, but mechanical strength is not enough in comparison with stainless steel. Therefore, solubility of tritium in Cu-Be alloy of which hardness is closed to stainless steel has been examined in this study.

The size of sample plates of Cu-Be alloy used in this study was 0.5x15x15 mm^3, and the composition of beryllium was 2 mass%. Tritium exposure was carried out using specially designed tritium exposure devices. Three kinds of tritium were applied, i.e., 0.4, 7.8 and 18.6 at.%T. Exposure time was changed from 4 to 11 hours, and exposure temperature was varied from 623 to 723K. The amount of tritium absorbed in the surface layers was examined by β-ray-induced X-ray spectrometry (BIXS), and a tritium depth profile in bulk of sample plates was measured by a chemical etching method.

Remarkable decline of tritium concentration in bulk was suggested by BIXS, and it was recognized from measurements of the tritium depth profiles that tritium concentration in bulk was 1000 times lower than that in surface layers. It was seen that the pressure dependence of tritium solubility obeyed the Zieverts' low. Dissolution of tritium in Cu-Be alloy was an endothermic reaction and the heat of dissolution was estimated to be 17 kJ/mol from the temperature dependence. In addition, it was seen that tritium solubility in Cu-Be alloy is about 10 and 300 times lower than that in oxygen-free copper and stainless steel, respectively. Accordingly, it was concluded that the present Cu-Be alloy can be applied as one of promising materials for parts of a high-level tritium handling devices.

This work was partly supported by the Grant-in-Aid for Scientific Research C (19560826).