Mechanism of tritium uptake and release at the SS316 surface

Y. Torikai\textsuperscript{a}, S. Naoe\textsuperscript{a}, R.-D. Penzhorn\textsuperscript{a}, K. Akaishi\textsuperscript{a}, K. Watanabe\textsuperscript{a}, M. Matsuyama\textsuperscript{b}, W. Shu\textsuperscript{c}, K. Kobayashi\textsuperscript{c}, K. Isobe\textsuperscript{c}, T. Hayashi\textsuperscript{d} and T. Yamanishi\textsuperscript{c}

\textsuperscript{a}Hydrogen Isotope Research Center, University of Toyama, Gofuku 3190, 930-8555 Toyama, Japan
\textsuperscript{b}National Institute for Fusion Science - NIFS, 322-6 Oroshi, 509-5292 Toki, Gifu, Japan
\textsuperscript{c}Tritium Process Laboratory, Japan Atomic Energy Research Institute, Tokai-mura, 319-1195 Ibaraki-ken, Japan
\textsuperscript{d}Division of Tokamak System Technology, Japan Atomic Energy Agency, Naka Fusion Institute, 801-1, Mukouyama, 311-0193 Ibarak, Japan

torikai@ctg.u-toyama.ac.jp

In an effort to understand the detailed mechanism that governs the transport of tritium through the SS316 stainless steel surface layer at ambient temperature a long-term study was carried out with several tritium-loaded specimens submerged into ion exchanged water under controlled conditions. The release rate of tritium into water, which was measured by liquid scintillation counting, was found to be determined by the diffusion flux from bulk to the surface at the surface boundary followed by ion exchange reactions between tritium on the surface and protium of water.

To verify the postulated mechanism and gain complementary information several SS316 specimens were thermally loaded with gaseous deuterium and immersed for extended periods of time into water containing tritium in the tens of GBq/cc range and maintained at ambient temperature. Tritium depth profiles building up progressively in the SS316 specimens were determined by chemical etching. The results provide experimental evidence that under these conditions all three isotopes of hydrogen dynamically interact with the metal.

The obtained release and uptake data are consistent with a diffusion model; they allow prediction of the chronic tritium release rate as function of temperature, specimen dimension and initial concentration.