Behavior of tritium near surface region of metals exposed to tritium plasma

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Tritium (T) behavior on surface and/or in subsurface regions is very important for safety. It is well known that the behavior is very complicated and sometimes quite different from that in bulk. In order to understand the T behavior on surface and/or in subsurface regions, we have applied a tritium imaging plate technique (TIP) to examine T depth distribution within a few μm for T loaded metals.

T was loaded on sample metal surfaces by deuterium (D) plasma discharge including T ($T/D = 10^{-3}$) in tritium plasma experiment (TPE). The surface was negatively biased with a voltage of 100 eV and the loaded temperature was at 393 K or 573 K for 2 h. The change of surface T concentration was monitored by TIP for 1 year with a time interval of a few months. The T depth distribution within a few μm could be determined by the TIP-film insertion method [1], in which TIP were repeatedly conducted with the insertion of a thin film to protect T beta-ray escaping from a depth depending on the thickness of the inserted film.

Immediately after the loading, the surface concentration of T loaded at 393 K was more than twice higher than that loaded at 573 K. By monitoring for 1 year, it was found that the surface concentration of T loaded at 393K gradually decreased, whereas that loaded at 573 K increased. The T depth distribution clearly showed the depletion of T within 0.5 μm depth from the surface for all samples. This suggests that the surface concentration was balanced by two processes; (1) release from the surface probably by isotopic exchange reaction with H in H_2O adsorbed from the atmosphere and (2) supply from the bulk by diffusion. Furthermore the balance was influenced by trapping effects both at surface and in bulk. Deeper and more precise depth profiling is under investigation by a surface layer removing technique applying an electrochemical etching to interpret the observed T behavior and/or to enable to estimate the T behavior at surface.

[1] K. Sugiyama, T. Tanabe *et al.*, Phys. Scr. T103 (2003) 56.