Tritium distribution on first wall carbon tiles in JT-60U

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Applying a tritium imaging plate (TIP) technique, we have examined a poloidal profile of tritium retention in carbon armour tiles on first wall of the low filed side of JT-60U. Analyzed tiles were exposed to several series of Deuterium (D) discharges heated by D neutral beam injection (NBI) (referred as DD discharge) with the total of ~18000 discharges in the period of 1991-2004. Each DD discharge series was followed tritium (T) produced by DD fusion reactions. TIP can detect by β electron generated by tritium retained within a depth of about 3.5 μm from top surface of carbon tiles.

The observed poloidal tritium profile was not uniform having two retention maxima, one at around the mid-plane and the other at poloidally a little higher zone than the mid-plane. In order to find the causes of such tritium retention profile, behaviour of tritium having 1 MeV produced by DD reactions in a typical high β_p H-mode plasma both for the open divertor configuration and the W shaped one using simulation code, Orbit Following Monte Carlo (OFMC) [1]. The results show that a certain amount of tritium is escaping from the plasma without fully losing its initial energy of 1 MeV and directly implanted to the first wall and the remaining are thermailzed in the plasma. Interestingly, a maximum flux of the escaping tritium appears at the upper zone and the mid-plane for the open shaped divertor configuration and the W shaped one, respectively. In previous works, it is found that D retained in near surface region during DD discharge was easily replaced by H during HH discharge, so as T in the near surface region. This suggests the T detected by TIP must be retained a little deeper region escaping from the isotope replacement. Therefore, we can conclude that the observed T retention maxima was caused by the injection of high energy T escaping from the plasma and even the retention maximum given by the open divertor configuration was not full removed by the following discharges with W shaped divertor on, and accordingly the two retention maxima were remained. The same T retention mechanism was confirmed in the T retention profiles in the divertor region in JT-60U and ASDEX Upgrade [2].

Reference

[1] K. Masaki, et al., JNM 313-316 (2003) 514-518
[2] K. Sugiyama, et al., JNM 337-339 (2005) 634-638