Electromigration of tritium in V-4Cr-4Ti alloy

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Vanadium alloys are one of candidate blanket materials for a fusion reactor equipped with a liquid lithium cooling system. An alloy V-4Cr-4Ti (NIFS-HEAT-2) developed by National Institute for Fusion Science has been widely investigated in its superier materials properties. We have also studied effects of alloying elements on tritium diffusion and trapping in this alloy[1-3]. In the fusion reactors, materials are subject to electric and magnetic fields, which could cause local accumlation of tritium by electromigration and/or magnetic fields effect. In the present study, the tiritum electromigration in the V-4Cr-4Ti alloy has been studied experimentally to determine its effective charge Z^*.

V-4Cr-4Ti bars ($3\times0.2\times25$ mm^3) were used as a specimen. Tritium was loaded on the specimen with a gas absorption method at 773 K under hydrogen gas pressure of 100 Pa which contained 1 appm tritium. In order to homogenize hydrogen distribution, the specimen was isothermally annealed and the uniform tritium distribution was confirmed by means of an imaging plate (IP) technique. Then, both ends of the specimen were set to two electrodes to impose an electric field (5.5V/m) in the specimen kept at a constant temperature ranging from 330 K to 423 K. The duration for imposing the electric fields was set to be five times longer than the diffusion relaxation time to attain the steady-state tritium distribution. Then, the tritium distribution in the specimen was profiled by the IP technique at a liquid nitrogen temperature to avoid tritium migration. The effective charge Z^* of tritium was determined from the tritium distribution according to a simple electromigration theory. Z^* showed positive values and increased with increasing temperature from 0.6 at 330 K to 0.9 at 423 K. This means, therefore, tritium migrates to a cathode side and its local accumulation due to electromigration should become more significant at higher temperatures.

In the presentation, trapping effects of alloying elements on tritium electromigration will be also discussed.

[1] K. Hashizume *et al.*, Fusion Sci. Technol., 54(2008)553.
[2] K. Hashizume *et al.* , J. Nucl. Mater., 367-370(2007)876.
[3] J. Masuda *et al.* , J. Nucl. Mater., 363-365(2007)1256.