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ABSTRACT-a9a0

An effectiveness of deuterium electrochemical charging method for a desorption study in low-alloy steel and pure Zr

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The purpose of this paper is to establish the effect of conditions of electrochemical deuterium (D) charging under galvanostatic conditions of low-alloy steel and pure Zr and to propose the optimum parameters of charging process for simple and reliable thermal desorption spectrometry study (TDS) of materials relevant to nuclear industry.

In spite of numerous investigations into the retention and diffusion of Hydrogen (H) in fusion and fission related materials, there is a large scatter in the experimental data and little agreement on the activation energy of H de-trapping. The reasons are mainly related to the complexity to execute the experiment and a lack of a clear distinction between the naturally occurring H in the materials and intentionally introduced for the experiment, thus often complementary or contradictory mechanisms of H retention and desorption have been proposed.

This work aims to determine a reliable electrochemical route to introduce D into metals, to assess the quantity of deuterium introduced into materials and to define the parameters detrimental for controllable D adsorption and desorption at galvanostatic conditions. The electrolytes were prepared from 99.99% D_2O (heavy water), and includes H_2SO_4 or $HAsNa_2O_4$. The heavy water was chosen to clearly distinguish between naturally occurred hydrogen and its isotope D introduced to the material. The charging process was carried out at current densities from 1 to 200 mA/cm^2 for various time. Complementary analysis of D depth distribution in Zr was performed by ToF-SIMS. The overall conclusion is that the current densities as low as $5mA/cm^2$ and time approximately of 30 minutes are sufficient to introduce D into analysed materials to saturate structural trapping sites, allowing repeatability of the experiments, as well as reducing time and cost of the tests.

Keywords

Hydrogen retention,Duterium,Zr,Ferritic steel,TDS.

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