

THE INFLUENCE OF NITROGEN INTERSTITIAL IMPURITY ON TEMPERATURE RANGES OF DEUTERIUM RETENTION IN AUSTENITIC STAINLESS STEEL

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Introduction

The ICHMS'2005 Abstracts Book will consist of two-page Extended Abstracts. Extended Abstracts are to be divided into sections and subsections. Temperature ranges of deuterium retention in austenitic stainless steel 18Cr10NiTi (of AISI304L type) pre-implanted with nitrogen ions have been determined.

Results and discussion

The nitrogen ion pre-implantation is demonstrated to extend the temperature ranges of deuterium retention up in temperature. The temperature range values are dependent on the dose (concentration) of implanted nitrogen. The introduction of nitrogen interstitial impurity was performed through implantation of 28 keV N_2^+ ions at a temperature of ~ 300 K in the dose range from 3.5×10^{16} N/cm² to 1.8×10^{17} N/cm². Following nitrogen implantation, the specimen cooled down to ~ 140 K was subjected to implantation with 14 keV D_2^+ ions to a dose of $\sim 1.5 \times 10^{16}$ D/cm². The specimens successively irradiated with nitrogen and deuterium ions were heated up to ~ 1500 K at an average rate of ~ 5 K/s under conditions of linear rise in temperature. In the process of heating, masses of 4 and 28 AMU were registered.

The analysis of deuterium thermodesorption spectra from steel 18Cr10NiTi has shown that the presence of nitrogen interstitial impurity at a level of 3.5×10^{16} N/cm² brings no change in the position of the gas evolution peak maximum on the temperature scale (see Fig.). However, in this case, the peak spread up in temperature is observed, and this is correspondingly followed by widening of the deuterium gas release region. A further increase in the N_2^+ pre-irradiation dose leads to a constantly increasing temperature range of deuterium release. The thermodesorption spectrum shows evolution from a complicated structure with poorly resolved peaks at a dose of

$\sim 6.5 \times 10^{16}$ N/cm² to a structure with well resolved two peaks with the peak temperatures of ~ 410 K and ~ 640 K as a dose of 1.8×10^{17} N/cm² is attained. In this case, the deuterium gas release occurs in the temperature range from ~ 330 K to ~ 1000 K. This suggests a conclusion that the presence of nitrogen interstitial impurity in the steel 18Cr10NiTi leads to an extension of the temperature range of deuterium retention up in temperature.

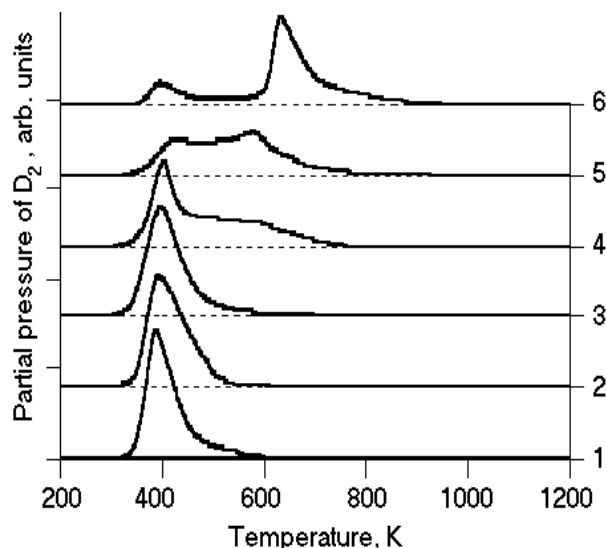


Fig. Thermodesorption spectra of deuterium implanted into steel 18Cr10NiTi at $T_{\text{irr}} \approx 140$ K for dose $\sim 1.5 \times 10^{16}$ D/cm² the nitrogen ion pre-implantation for different irradiation doses:

- 1 – 0; 2 – 3.5×10^{16} N/cm²; 3 – 5×10^{16} N/cm²;
4 – 6.5×10^{16} N/cm²; 5 – 1.1×10^{17} N/cm²;
6 – 1.8×10^{17} N/cm²

Conclusions

The presence of nitrogen interstitial impurity in the steel 18Cr10NiTi leads to an extension of the temperature range of deuterium retention up in temperature.