Nanostructured surfaces

Trapping of deuterium injected in austenitic steel at elevated temperatures

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As is known, hydrogen, which is accumulated in austenitic steel as a result of interaction with the environment, irradiation in fission/fusion reactors, is one of the elements that can cause structural changes in the steel. The present paper reports the results from studies on the retention of ion-implanted deuterium in austenitic steel 18Cr10NiTi at elevated radiation temperatures: 295, 380, 420, and 600 K.

Deuterium was introduced into the samples through implantation of 12 keV ions in the dose range from 5×10^{16} to 1×10^{18} D/cm^2. Thermal desorption spectra (TDS) of deuterium were used to investigate the kinetics of the development of structural changes versus implanted deuterium dose.

At a temperature of 295 K, the TDS from steel show three temperature regions of deuterium desorption: (1) the peak with the maximum temperature T_{max}= 380 K (solid solution of deuterium in steel) with deuterium concentration of 2.5 to 3 at.%D; (2) the peak with T_{max}=440 K and the retained deuterium concentration of 7 to 8 at.%D; (3) the region in a wide temperature range from 450 to 900 K with T_{max}~500 K.

At a temperature of 380 K, the TDS from steel exhibit a wide deuterium desorption region extending from 380 to 1200 K, with poorly resolved peaks having T_{max}~ 500 K, 700 K and 1050 K (local structure).

At temperatures of 420 and 600 K, the TDS show an extended region of deuterium desorption in the temperature range from the radiation temperature up to 1200 K, treated as being due to diffusion processes in the implantation layer. In this case, structureless regions are formed along the crystallite-local structure boundaries; steel components segregation also takes place.

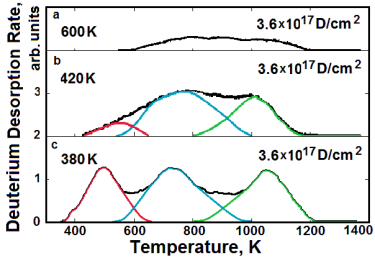

Fig. 1. Deuterium TDS from steel at different temperatures