Contribution ID: **42** Type: **contributed**

Transport and deuterium interaction with defects in W, EUROFER and W-Cr-Y alloys damaged by heavy ions

Tuesday 27 May 2025 16:20 (20 minutes)

To simulate neutron-induced defects, materials have been irradiated with Fe ions with an energy of 5.6 MeV at a temperature range of 250-500C and dose range of 3-50 dpa. The radiation defects have been investigated by transmission electron microscopy (TEM), energy-dispersive X-ray spectrometry (EDXS), atom probe tomography (APT) and positron annihilation spectroscopy (PALS). To decorate radiation-induced defects, D was implanted in damaged materials with an energy of 670 eV to a fluence of 1022 D/m2. The D retention was studied by in-situ thermal desorption spectroscopy (TDS) in order to avoid changes in the surface conditions as a result of the sample's contact with air after irradiation.

It was found that (i) radiation-induced defects are mainly vacancy-type defects in W and (ii) the radiation-induced Cr clusters suppresses the formation of both vacancy-type and dislocation-type defects in the W-Cr-Y alloy. In contrast, the formation of radiation-induced Cr-Mn clusters in Eurofer does not mitigate the dislocation loop development. It was shown that TEM method leads to underestimation of small particles and clusters: smaller particle sizes and vacancy clusters with densities an one order of magnitude higher than those measured by TEM were measured using APT and PALS methods, respectively. Therefore, it is necessary to use several experimental methods to determine the micro- and nanostructure of materials, since each of them has its own limitations. Validation of models against only TEM data (which is currently often used) may be incorrect and can lead to misunderstanding of the underlying physics.

The accumulation of D in radiation defects in W and Eurofer is an one order of magnitude higher than in undamaged materials, but is either does not change or only by a factor of 1.4 higher in damaged W-Cr-Y alloy compared to undamaged W-Cr-Y alloy. The accumulation of D in radiation defects correlates with a formation of (i) vacancy clusters in W, (ii) Cr clusters in W-Cr-Y alloy and (iii) Cr-Mn clusters, dislocation loops and vacancy clusters in Eurofer. The modelling of migration and trapping of D in each type of intrinsic and radiation-induced defects has been performed, and the binding energies of D with defects were determined.

Primary author: Dr OGORODNIKOVA, Olga (National Research Nuclear University "MEPHI"(Moscow Engineering Physics Institute))

Presenter: Dr OGORODNIKOVA, Olga (National Research Nuclear University "MEPHI"(Moscow Engineering Physics Institute))

Session Classification: contributed