gas-driven permeation (GDP) by which bred T is transported from the breeding blanket to the edge plasma.

The first phase of investigation: 2011-2014 focused on F82H without protective coatings and the second phase: 2015-2017 has been intended to evaluate the effects of tungsten coatings on hydrogen isotopes permeation. From the first phase, as shown in Fig. 1, it was found out that the GDP-T flux can be just as high as 1 torr liter/cm^2/s, meaning that the total GDP flow of T into the edge plasma can be of the order of 1000 torr liters/s for a DEMO reactor with the total first wall surface area of typically ~1000m^2. In contrast, the PDP hydrogen flux was measured to be orders of magnitude lower than this.

Based on these data, the use of a permeation barrier has been proposed and tungsten has been chosen as the coatings material. In the second phase of investigation, tungsten coatings have been prepared by: (1) vacuum plasma spray (to be referred to as VPS-W), and (2) sputter deposition (to be referred to as SP-W). From the materials characterization analysis, it has been found that VPS-W has relatively low densities ~90% with connected pores whereas SP-W has densities as high as 99.5%.

It has been found that VPS-W coatings can suppress only hydrogen PDP from the plasma side, whereas SP-W can suppress only hydrogen GDP from the blanket side [3]. Therefore, the use of VPS+SP double layer coatings has recently been proposed, and the preliminary data (to be published) indicate that both PDP and GDP can be suppressed by several orders of magnitude.

[1] A. SAGARA et al., Fusion Technol., **39**(2001)753.

[2] Yoshi HIROOKA and H. ZHOU, Fusion Sci. Technol. **66**(2014)63.

Hydrogen retention in RAFMs –Current status of investigation

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In next-step fusion devises (DEMO reactor and hybrid fusion-fission reactor) neutron fluxes and resulting damage of materials will be significantly higher than in ITER. The tritium decay will lead to formation of radiogenic helium in the bulk of plasma-facing and constructive materials. These processes will lead to structure changes of materials and will influence tritium retention.

The aim of the project is to model experimentally damages in fusion facilities and investigate their influence on hydrogen retention in RAFMs. One of the main goals is to investigate influence of radiogenic He formation on deuterium retention afterwards. For radiogenic He creation in materials the “tritium trick” method was selected. In this method samples are exposed in tritium gas, dissolving some amount of tritium. The one should wait for He formation in reaction of T decay:

${}_1T^3 \rightarrow {}_2He^3 + e^- + \nu$,

and after necessary time remove T from samples by annealing.

A new installation for samples exposure in tritium was designed and manufactured in A.A. Bochvar’s institute, Russia. Materials under investigation was Rusfer and Eurofer RAFMs, austenitic steel ChS68, W and CuCrZr bronze for comparison. For the first samples were exposed in D_2 gas at a pressure of 20 atmospheres, temperature of 673 K during 24 and 100 hours. The deuterium retention was measured by TDS method.

The result on deuterium retention were repeatable for samples of the same material exposed at the same conditions. Deuterium retention in materials is distributed the following:

Retention in bronze > retention in austenitic steel > retention in RAFMs Rusfer > retention in W.

The “>” sign means the difference about an order of magnitude. It was concluded that exposition during 24 hours is enough for saturation the materials.

The exposition in T gas was performed at a pressure of 8 atmospheres, temperature 673 R during 24 hours. The imaging plate method was used for estimation of T distribution across the surface. The samples were left in inert gas for He^3 production. It is planned to make detritisation of first portion of samples within half a year.

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