EXPERIMENTAL techniques and facilities FOR study of gas release and accumulation of hydrogen isotopes in fusion reactors MATERIALS [[1]](#footnote-1)\*)

DOI: 10.34854/ICPAF.2020.47.1.187

1Bobyr N.P., 1Spitsyn A.V., 2Kulevoy T.V., 1Khripunov B.I., 3Anikin A.S.

1NRC Kurchatov Institute, Moscow, Russia, Bobyr\_NP@nrcki.ru
2NRC Kurchatov Institute - ITEP, Moscow, Russia
3JSC VNIINM, Moscow, Russia

The task of studying the accumulation of hydrogen isotopes in materials of modern fusion reactors (FR) is one of the most important tasks for the fuel cycle and ensuring safety. Outside of a fusion reactor, it is impossible to model the complex effect of neutron, plasma, and energy flows on the hydrogen interaction with wall materials. For this reason, to obtain preliminary data, it is necessary to carry out experimental modeling of the effects of individual factors present in the FR on materials and their interaction with hydrogen isotopes.

Currently, the following FR structural materials are being studied in the world: tungsten and tungsten alloys, bronze, low-activated steels and vanadium alloys. In addition to these materials, many other materials that make up high-tech equipment will be present in the FR chamber. All of these materials should be investigated in terms of gas release [1]. Especially important to study the impact of hydrogen isotopes release from materials containing structural defects.

In this paper, experimental methods for studying the transport and accumulation of hydrogen isotopes, including those containing structural defects, are presented. The created system for irradiating samples of FR materials with a size of 10\*10 mm2 with heavy ions to simulate neutron irradiation based on the HIPr linear accelerator (NRC KI - ITEP) is presented [2]. The system allows irradiating simultaneously up to 4 samples in the temperature range 293-773 K with a defect development rate of at least 0.05 dpa/h. Saturation of samples of materials with deuterium from the gas phase is carried out at the Atlan facility (NRC KI) at a pressure of up to 105 Pa and a temperature of up to 1000 K. Saturation of samples of materials with tritium from the gas phase is carried out at the REKA2 facility (AO VNIINM) at a pressure of up to 106 Pa and a temperature of up to 1000 K. Irradiation of samples of materials with deuterium plasma is carried out at the LENTA facility (NRC KI) at flows up to 1021 D/m2 and temperatures up to 1000 K [3]. The analysis of the deuterium content in the samples of materials is carried out using the method of thermal desorption spectroscopy on a specialized TDS stand (NI KI) that allows linear heating of the samples to a temperature of 1100 K. The combination of available methods and facilities allows NRC KI employees to successfully use them to study the accumulation of hydrogen isotopes in various FR materials, including those containing structural defects.

The work was supported by the NRC “Kurchatov Institute” (16.07.2019 № 1570)

References

1. ITER Vacuum handbook
2. A.V. Spitsyn, N.P. Bobyr, T.V. Kulevoy, P.A. Fedin, A.I. Semennikov, V.S. Stolbunov "Use of MeV energy ion accelerators to simulate the neutron damage in fusion reactor materials" Fusion Engineering and Design, Volume 146, Part A, September 2019, Pages 1313-1316
3. N.P. Bobyr, V.Kh. Alimov, B.I. Khripunov, A.V. Spitsyn, M. Mayer, Y. Hatano, A.V. Golubeva, V.B. Petrov, “Influence of helium on hydrogen isotope exchange in tungsten at sequential exposures to deuterium and helium–protium plasmas” Journal of Nuclear Materials 463 (2015) 1122–1124
1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLVII/E/ru/IL-Bobyr.docx) [↑](#footnote-ref-1)