TESTS OF LIQUID-METAL LITHIUM AND TIN CAPILLARY-POROUS SYSTEMS IN PLM PLASMA device [[1]](#footnote-1)\*)

DOI: 10.34854/ICPAF.2020.47.1.193

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Capillary-porous systems (CPS) with liquid metals lithium Li and tin Sn [1-3] are considered to solve the problems of plasma-facing invessel components of a fusion neutron source and DEMO reactor. The main advantages of CPS in comparison with solid materials are their resistance to degradation of properties and the ability to self-repair the surface based on capillary forces under normal discharge conditions, ELMs, and disruptions. The upper limit of thermal loads for KPS with Li and Sn in stationary operation is close to 18–20 MW / m2. In the PLM plasma device [4], plasma tests of CPS with lithium and tin were carried out. CPS manufactured at JSC "Red Star". These CPS are modeled lithium CPSs used in experiments in T-10, T-11M tokamaks. . The lithium CPS in the form of a mat between molybdenum grids is fixed in a molybdenum module with a diameter of 35 mm. Tin CPS consists of tin tiles measuring 15x15x1 mm, placed in a mat between molybdenum nets. The CPS was fixed in a stainless steel module (in the form of a cylindrical bathtub with a diameter of 20 mm and a height of 2 mm) of grade 12X18H10T. Tin CPS in stationary plasma was tested for the first time.

Lithium and tin CPSs were tested in PLM device for 3 hours in a helium discharge with plasma parameters: density about 1x1012 cm-3, electron temperature of 2-5 eV with a fraction of hot electrons up to 50 eV. The plasma load was at the level of 1 MW / m2. The heating of the CPS was provided by biasing voltage to the modules of the CPS, at which a flux of hot electrons from the plasma entered the surface. During the exposure, optical and pyrometric observations recorded the heating of the CPS. Optical emission spectra from plasma contained lines of single ionized lithium ions in tests of lithium CPS and lines of single ionized tin ions in tests of tin CPS. The redeposition of lithium vaporized from the CPS surface on the walls of the PLM chamber was detected. Inspections of CPS modules after testing did not reveal damage of molybdenum grids. The experiment is the basis for further large-scale studies of the CPS at high plasma loads and assess the prospects of using CPS in thermonuclear devices. This work was supported by the RNF grant 17-19-01469, the microscopic analysis of the modules was supported by the RFBR grant 19-29-02020, the production of ASNI was supported by the Megagrant of the Russian Federation No. 14.Z50.31.0042.

References

1. S.V. Mirnov et al. J. Nucl. Mater., 2013, vol. 438, p. 224-228.
2. S.V. Mirnov et al. Fus. Eng. and Des., 2012, vol. 87, p. 1747-1754.
3. I.E. Lublin, A.V. Vertkov, V.V. Semenov, VANT. Ser. Thermonuclear Fusion, 2015, vol. 38, no. 1, pp. 7-15.
4. V.P. Budaev et al. VANT ser. Thermonuclear Fusion, 2017.40, 3, 23

1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLVII/E/ru/IR-Budaev.docx) [↑](#footnote-ref-1)