Methodology of the Experiments to Study Lithium CPS Interaction with Deuterium Under Conditions Of Reactor Irradiation

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Problems of plasma-facing materials degradation and in-vessel element destructions, tritium accumulation and plasma pollution can be overcome by the use of liquid metals with low atomic number. The best candidate as a material for divertor receiving plates and other in-vessel devices is lithium. Liquid lithium advantages as a plasma facing material have been confirmed by a large number of the experiments at the plasma-physical facilities being operated worldwide.

One of the problems associated with the use of such liquid lithium systems in the fusion reactors is to determine the parameters of the working gases interaction with plasma facing surfaces under conditions simulating real operation, i.e. under conditions of neutron and gamma radiation. Therefore, one of the important goals is to research the processes of hydrogen isotopes interaction with lithium capillary-porous systems (CPS) under reactor irradiation.The first phase of the studies was to develop a technique for lithium CPS sorption experiments at deutrium pressure of 0.1 – 100 Pa and samples' temperatures of 100 – 800°C.

This paper describes a technique of the reactor experiments to study lithium CPS interaction with deuterium under neutron irradiation. The radiation source was IVG 1.M reactor of National Nuclear Center RK. In particular, the neutron-physical calculations were performed by using the MCNP software, which allowed to estimate the generation rates of ^{3}H and He in lithium CPS during its irradiation in IVG.1M reactor, and to determine energy release during ions thermalization. ANSYS software packages were used for thermophysical calculations of an irradiator for various temperature regimes of lithium CPS, and the distribution of temperature fields in the experimental cell was determined for different reactor power levels. The neutron-physical and thermophysical calculations were the basis for development of the design and further manufacture of a unique irradiation ampoule device with a lithium CPS sample. A number of the experiments was performed to calibrate deuterium fluxes through an experimental cell with lithium CPS and preliminary results of these experiments were obtained. The new design of the experimental cell allows to carry out the experiments on tritium generation and release from lithium CPS under conditions of reactor irradiation at the temperatures above 500°C. The research is carried out in the framework of ISTC K-2204 project.