Using beryllium as a neutron multiplier in the blanket of DEMO, the parameters of tritium retention and release are important to provide the efficiency and the safety for the fusion reactor. In the European Helium Cooled Pebble Bed (HCPB) blanket concept for the DEMO the production of about 80 dpa, up to 25 000 appm helium and 700 appm tritium in beryllium is planned. In the test blanket module (TBM) of ITER the production of 1 dpa, about 300 appm helium and up to 10 appm tritium can be reached. A priori it is possible to assume that tritium permeation, retention and release properties can be depended on a method of tritium loading into beryllium pebbles. Under neutron irradiation in a research nuclear reactor the formation of tritium takes place homogeniosly in the microstructure by nuclear reactions of neutrons with beryllium atoms. This is the best method for the loading of tritium into beryllium. It is also possible to load tritium without irradiation but at high temperature and pressure of the tritium/hydrogen gas mixture. In this case it is necessary to prove uniformity of the tritium saturation into the pebble after the loading.

In this study beryllium pebbles with diameter of 1 mm produced by the rotating electrode method at NGK were used. Tritium was loaded into pebbles in the special facility with the use of the H_2 – 500 wppm T_2 gas mixture at 473-1373 K with a temperature step of 100 K for 1, 6 and 12 h at a pressure of 4 bar. The activity of released tritium during thermodesorption tests has been measured using proportional counter. The measurements were carried out in a flow gas of He+1% H_2 under heating up to maximal temperature of 1373 K at a heating rate of 7 K/min. Measured tritium release rates and specific released activity from beryllium pebbles are presented and analyzed. Ion beam analysis using Elastic recoil detection analysis (ERDA), Rutherford backscattering (RBS) and Particle-induced X-Ray emission (PIXE) techniques for an examination of the pebble surface layer was performed. The thickness of the beryllium oxide layer which is formed on the surface of the beryllium pebble after the tritium loading was measured. The character of hydrogen/tritium penetration through the surface oxidized layer was defined. Hydrogen/tritium permeation, retention and release properties of the pebbles after preliminary oxidation in air at 873 K and 1073 K within 1 hour are investigated. The results are discussed with the use of the data on microstructure examination of beryllium pebbles by optical metallography and Scanning Electron Microscopy (SEM).

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