§5. Development of Hydrogen Isotope Oxidation Process by Atmospheric Pressure Plasma

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A feasibility of hydrogen oxidation process by atmospheric pressure microwave discharge have been investigated from the viewpoint of tritium safe-handling.

Recovery of leakege tritium in a nuclear fusion reactor building is one of the important issues because the tritium is a radioactive isotope of hydrogen. So far, the tritium recovery system removes tritium from a gas by cracking the tritium-containing components on a heated precious metal catalyst. The tritium combines with oxygen in the air stream to form tritiated water. Then the tritiated water contained in the air stream is removed by a molecular sieve bed. Although this system has suitable performance efficiency, there are some problems for high pressure drop, the utilization of a large amount of precious metals and heating efficiency etc, when the processing throughput is quite huge. In order to resolve the issues, we have proposed a hydrogen isotope oxidation process by an atmospheric pressure plasma. This method have the advantages; low pressure drop, without noble metals such as platinum and palladium, hydrogen and oxygen radicals are easily generated by high energy electron and ion impact etc.

Experimental studies on hydrogen isotope oxidation by an atmospheric pressure plasma generated by 2.45 GHz microwave discharge have been done. As shown in Fig. 1, Argon was used as an operational gas. Small amount of hydrogen and oxygen were mixed in the combustion gas during the discharge. The constituents of a gas mixture at the outle of device was observed by a quadruple mass spectrometer. To clarify the detail of the oxidation process, preliminal measuremt of optical emisson has been done. Notice that hydrogen was simulated tritium in this experiment.

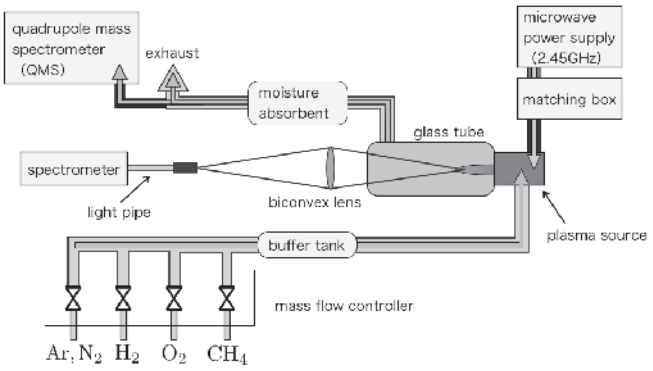

Fig. 1 Experimental setup for hydrogen oxidation using atmospheric pressure microwave discharge.

The degree of hydrogen oxidation, so called conversion rate, is increased as increasing the input microwave power (Fig. 2). Maximum hydrogen conversion rate was reached to 85.5% in this experimental condition. Figure 3 shows results of the optical spectroscopy measurement under various conditions. The optical emission spectra from oxygen, hydrogen and OH radicals was observed. These results indicate OH radical would be key particle to oxide hydrogen gas.

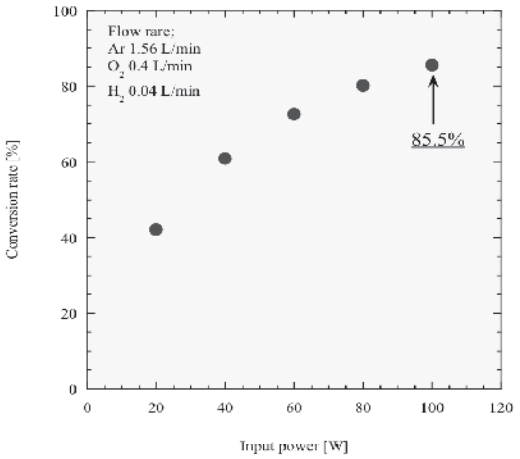

Fig. 2. Dependence of conversion rate on input microwave power for argon plasma..

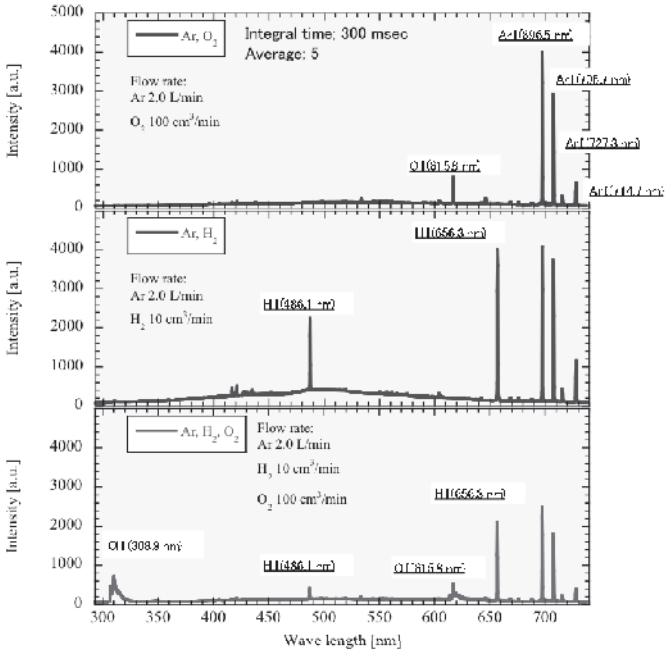

Fig. 3. Optical emission spectra from the atmospheric pressure microwave argon plasma with hydrogen and oxygen.