

§5. Development of More Sophisticated Tritium Recovery System of Fusion Power Plant

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The catalytic oxidation and adsorption is the most conventional and reliable method for removing tritium that is accidentally released into the working area of these facilities. The catalysts used for these purposes need to have high catalytic performance for low temperature combustion of tritium and tritiated methane. Up to now, the authors have worked on the development of such catalysts. However, if the actual process is considered, there are further demands for catalyst and catalytic process. For example, if accidental tritium releases take place, large amounts of air should be processed by the air cleanup system. Therefore, the air cleanup system needs to be designed to be able to deal with the air with high volumetric velocity. Other than this, compactness and simplicity, efficient heating and endurance in long term use and repeated use are also required. With this background, the authors tested the applicability of honeycomb catalysts, which is considered to be effective for the treatment of high throughput process gas and efficient heating, for catalytic oxidation of tritium tritiated methane. The results indicate that the use of honeycomb type of catalysts is effective for oxidation of hydrogen isotopes and methane. The pressure drop along the honeycomb catalysts is much smaller than packed bed catalysts, as well. Thus, the purpose of this study is to investigate the applicability of honeycomb catalysts to the tritium recovery system of fusion power plants. For this purpose, the test fabrication of honeycomb catalysts was carried out, and their catalytic performance for oxidation of hydrogen were examined. This

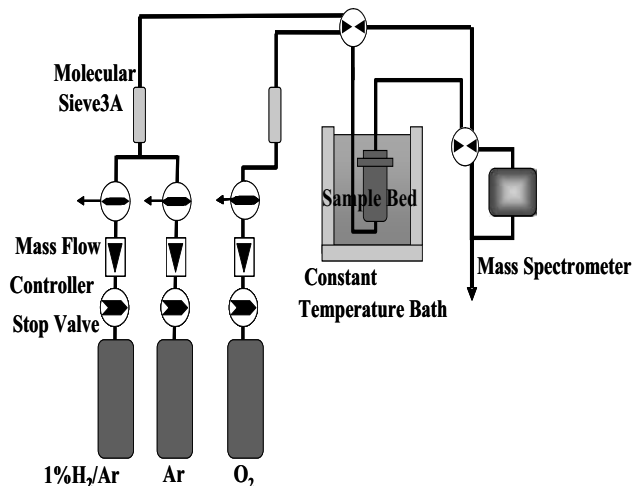


Fig.1 Flow diagram of experimental apparatus

time, the effect of modification of substrate materials of honeycomb on catalytic activity was chiefly investigated.

Figure 1 shows the flow diagram of the experimental apparatus used in this study. In the experiments, the catalysts were charged in a reactor made of quartz. The temperature of the reactor was varied in the range of 0 to 80 °C. The argon gas containing hydrogen (0.1 %) and oxygen (20%) was introduced to the reactor. The concentration of hydrogen at inlet and outlet stream of the reactor was measured with a mass spectrometer. The flow rate (10,000 l/h of space velocity) was controlled with conventional mass flow controller. The catalysts used in the experiments are 2g/L Pd/NA, 2g/L Pt/NA-S, 2g/L Pd/NA-S, 2g/L Pt/NA-C and Pd/NA-C honeycomb catalysts manufactured by Nagamine manufacturing Co., Ltd. The NA-S honeycomb was prepared using silica powder of 0.1 mm particle size. With regard to the NA-C honeycomb, an activated charcoal was added in its fabrication process. The catalysts were reduced under the stream of hydrogen at the temperature of 350 °C before the experiments.

Figure 2 shows the conversions hydrogen over catalysts used in the experiments as a function of temperature. As seen in the figure, the catalytic activity of 2g/L Pt/NA-S is highest, which is followed by 2g/L Pt/NA-C, 2g/L Pd/NA-S, 2g/L Pd/NA and Pd/NA-C. Difference in substrate materials appears to affect catalytic activity. It is also seen that Pt is a better catalyst metal. The measurement of BET surface area indicates that the BET surface areas of NA, NA-S and NA-C are 15.24, 10.278 and 8.202 m²/g respectively. Thus, some reasons other than BET surface area might affect catalytic activity. In terms of the NA-S honeycomb, silica with larger particle size was used in its fabrication process. Thus, there is a possibility that the diffusion rate of hydrogen in the honeycomb substrate was improved by adding the larger particle size of silica.

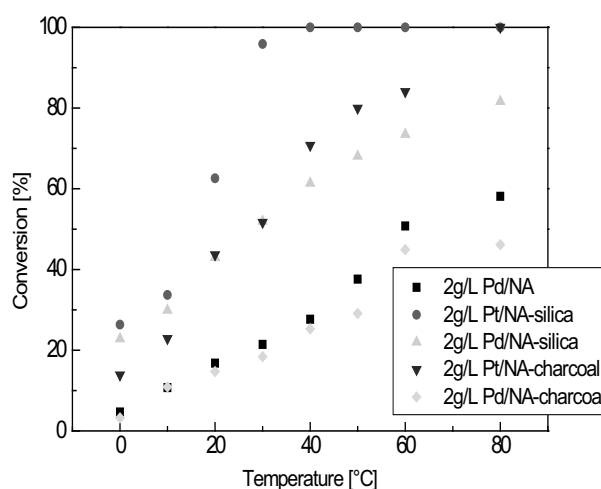


Fig.2 conversions of hydrogen over catalysts