§9. Evaluation of Pressure Drop and Hydrogen Oxidation Performance of a Honeycomb Catalyst Impregnated with the Noble Metal

Uda, T., Tanaka, M.

In the field of nuclear fusion engineering, the recovery of tritium is one of the issues of safety. If the accidental release of tritium occurs in a nuclear fusion power plant, large volumes of air should be treated by tritium recovery system such as ECS (Emergency Cleanup System) etc. Hence, the cleanup system should be designed to be able to treat the gas with high volumetric velocity. A conventional tritium recovery system is composed of an oxidation catalyst and an adsorbent material. Some of commercially-available ready-made catalysts, which are made of ceramic particles impregnated with the noble metals such as platinum (Pt), palladium (Pd) etc, are applied to the tritium recovery system and have the adequate oxidation performance. However, the volume of the particle-packed catalyst bed increases with increase the process gas flow rate. The high throughput of air causes pressure drop in the catalyst bed, which results in high load on the pumping system. Therefore, we proposed the application of a honeycomb type catalyst, which are generally used in the automotive industry, instead of the conventional particle-packed catalyst bed in the tritium recovery system. It is considered that the honeycomb type catalyst has an advantage in terms of pressure drop in compare with particle-packed catalyst beds. In this study, the pressure drop and the oxidation performance of honeycomb catalysts were evaluated.

We chose two types of the honeycomb catalyst made of metal and ceramic as a base material. The shapes of each honeycomb catalyst were 15 mm in diameter, 20 mm in length and 20 mm in diameter, 50 mm in length. The noble metal as a catalyst was platinum and the impregnated amount was 1 g/L and 2 g/L. The evaluation of the oxidation performances carried out at the same volume velocity. The sample gas was included 0.1% hydrogen and methane in air.

Pressure drop in the catalyst bed was measured for a packed bed with 1/8 inch and 1/16 inch type particles and a honeycomb catalyst made of ceramic. A comparison of the three types of bed reveals that the pressure drop in the honeycomb catalyst is smaller by one order of magnitude than that in the packed bed as shown in Fig. 1.

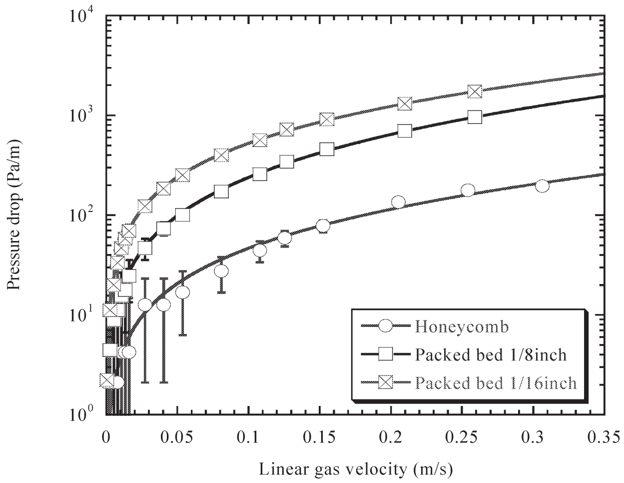

Fig. 1: Comparison of the pressure drop between the packed bed and honeycomb bed.

The subsequent issues to be studied involve the oxidation characteristics of the honeycomb catalyst bed. Figure 2 shows hydrogen gas oxidation reaction rate at the processing temperature of 50 ^{o}C. When amount of the noble metal was doubled, the oxidation reaction rate increased about two times regardless of a base material. The absolute reaction rate of the ceramic type honeycomb catalyst was an order of magnitude larger than that of the metal type honeycomb catalyst.

These experimental results regarding the hydrogen oxidation performance indicate that the ceramic type honeycomb catalyst is suitable for a high throughput of air cleanup system.

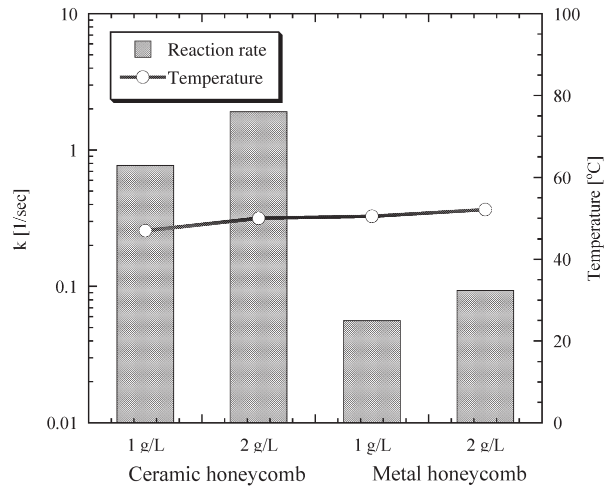

Fig. 2: Comparison of the hydrogen gas oxidation reaction rate between the ceramic and metal honeycomb bed