

§2. Development of Catalyst for Oxidation of Tritium in Room Air

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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 fusion power plants. This air-cleanup system, which consists of catalyst and adsorption beds, should be the last barrier to the emission of tritium to the environment, and thus its design is an important issue for the safety of the fusion power plants. The catalysts used for oxidizing tritium (HT , T_2) and tritiated methane (CH_3T) plays a key role in the air-cleanup system, and thus it is necessary to select or develop effective catalysts to oxidize such tritium species. In our previous work, the authors developed a catalyst, which consists of Pt and a MS4A adsorbent and tested its performance. This catalyst was designed and prepared to directly capture oxidized HT and CH_3T into its substrate (MS4A) through adsorption and isotope exchange reactions. However, its oxidation performance was not satisfactory. This time, the authors tried to improve the oxidation performance of such catalysts.

In this work, several fabrication techniques were tested to improve the catalytic performance. A MS3A adsorbent was used for the catalyst substrate. A Pd solution was used in the fabrication of catalysts. The experiments were performed using a packed bed reactor. About 1 g of each catalyst was placed in the reactor. An Argon gas containing ~ 1000 ppm of H_2 , ~ 1000 ppm of CH_4 and $\sim 20\%$ of O_2 was introduced to the reactor. The values of SV (reciprocal of residence time) range from 17,000 to 22,000 h^{-1} ; each catalyst was tested under the almost same condition. The temperature of the reactor was raised stepwise from ambient temperature to $400^\circ C$. At each temperature, the conversions of H_2 and CH_4 were measured under steady state conditions.

Figures 1, 2 and 3 show the conversions of H_2 and CH_4 over various catalysts. H_2 was almost completely oxidized at $150^\circ C$ over the catalysts (a)—a reference commercial Pd catalyst. CH_4 was almost completely oxidized at $400^\circ C$ over this catalyst. However, the conversion of H_2 was only 30% at $150^\circ C$ over the catalyst (b), which was developed in the previous work. Moreover, the conversion of CH_4 was only 10% even at $400^\circ C$. This result suggests that the catalyst developed in the previous work is not effective for oxidation of tritium species especially at lower temperatures. However, H_2 was almost completely oxidized even at $100^\circ C$ over the catalysts (c), which is the catalyst developed in this work. Comparison with the result for catalyst (b) suggests that the catalytic performance is considerably improved. Additionally, it was also found that the oxidation

performance for CH_4 is low. Thus, there is a possibility that this catalyst can be used in a monitoring system of environmental tritium, which requires selective oxidation of HT and CH_3T .

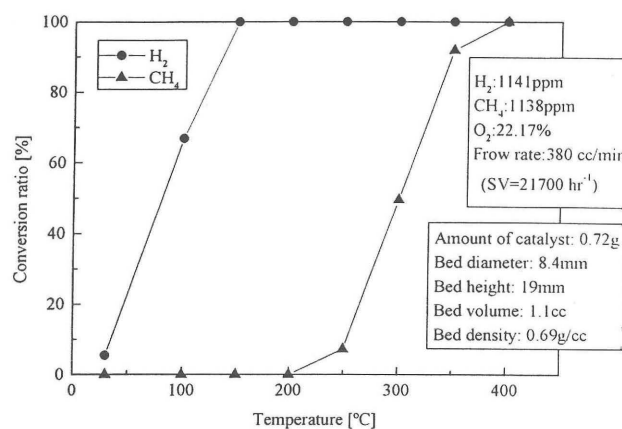


Fig. 1 Conversions of H_2 and CH_4 over (a) 0.3%Pd/ Al_2O_3 catalyst (G-68C)

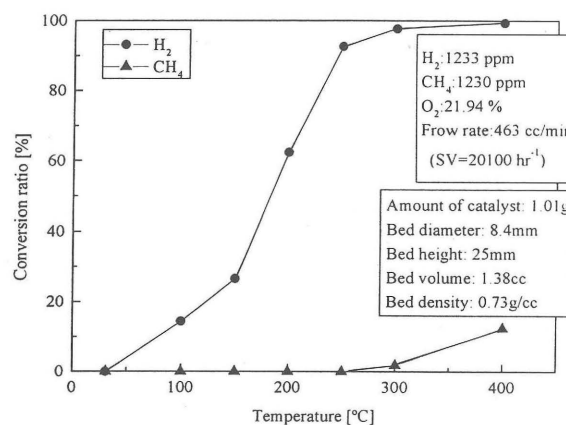


Fig. 2 Conversions of H_2 and CH_4 over (b) 0.5%Pt/MS4A catalyst

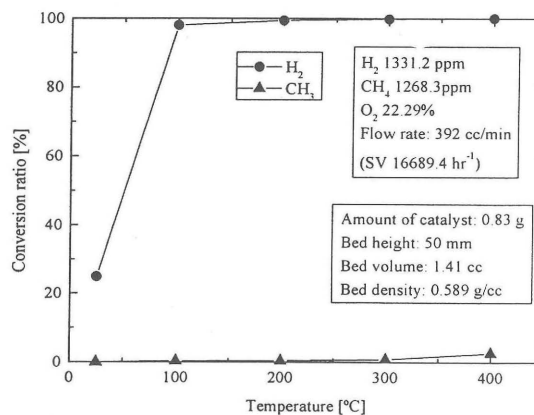


Fig. 3 Conversions of H_2 and CH_4 over (c) 0.5%Pd/MS3A catalyst