§ 11. Study on Separation of Hydrogen Isotopes Using Vycor Glass Tube

Ohta, M. (Niigata Univ. Eng.)
Takami, M. (Niigata Univ. Graduate School Sci. Tech.)
Sakuma, Y., Kawano, T.

1. Introduction

Tritium compounds that is a fuel for nuclear fusion and is slightly produced at nuclear power generation contains main tritium gas (HT) and minor tritiated water vapor (HTO). The dangerousness of HTO on human body is much higher than that of HT. Therefore, it is necessary to separate tritium compounds to each chemical form to maintain reasonably the safety and environment in a nuclear power plant. In this study, the separation cell used with the porous Vycor glass tube was proposed as the separation cell of tritium compounds. The adsorption of water vapor was investigated at various temperatures on the separation cell used with the porous Vycor glass tube in which residual water was eliminated by heat treatment at 453K.

2. Experimental

The separation cell consists of the porous Vycor glass tube (Corning Glass #7930, length: 155mm, internal diameter: 7.6mm and thickness: 1.2mm) and jacket tube (Pyrex glass). The porous Vycor glass tube is set up in the center of jacket tube (Pyrex glass) by using with silicon rubber and seal tapes. The micropore distribution and BET specific area of the porous Vycor glass tube was of approximately 2nm of maximum value and 220m^2g^{-1}, respectively. The temperature inside of the porous Vycor glass tube was controlled at 453K by used with nichrome wire heater and air flowing (0.7 L/min). The amount of water vapor adsorbed on the porous Vycor glass tube was measured at various temperatures in air flow containing water vapor (Relative humidity: 60% at 298K).

3. Results and Discussion

The adsorption of water vapor was investigated at various temperatures on the separation cell used with the porous Vycor glass tube in which residual water was eliminated by heat treatment at 453K (Fig.1). The maximum amount of water vapor adsorbed decreased and the interval reaching the maximum value was shorter with rising of adsorbing temperature. The adsorption of water vapor at 323-393K proceeds according to the formula of the first-order. Water vapor adsorbed hardly at 453K. These results were applied to Arrhenius' equation (Fig.2). The activation energy was estimated 0.62kcal.mol^{-1} and 6.6 kcal.mol^{-1} at 323-373K and at 373-393K, respectively. These facts suggest that the separation cell operated at 453K is able to inhibit permeation of HTO.

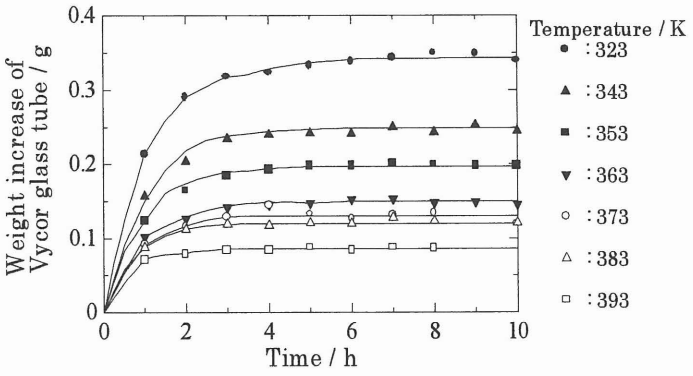

Fig1. Isotherm of water adsorption using Vycor glass tube exhausted with heating at 453K.

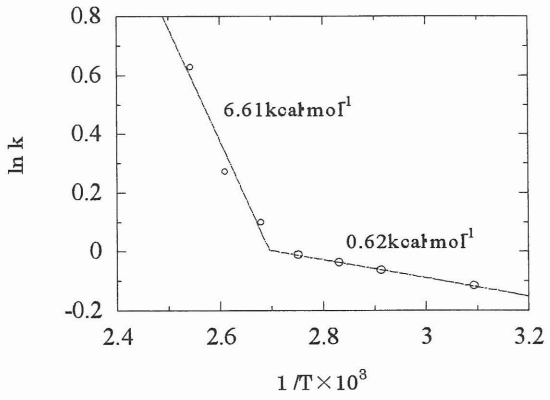

Fig.2 Arrhenius plot of water adsorption.