Temperature Variation of ZrCo Hydride Due to Hydrogen Absorption in a Rectangular Tray-Type Bed

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1. Introduction

A tritium storage vessel for a nuclear fusion plant requires the performance of fast tritium storage and supply [1-3]. ZrCo alloy metals have been used as a storage material for tritium. The hydriding of ZrCo alloy metals is an exothermic reaction, and dehydriding is an endothermic reaction. Dehydriding processes are performed by heating ZrCo hydrides. In this study, the ZrCo alloy metals of SAES Getters were used. The activation of ZrCo alloy metals and the powderization were performed. We present the temperature variation characteristics of ZrCo hydrides and trays.

2. Experimental Apparatus and Measurement

Fig. 1 shows a hydrogen tank and data acquisition system. The ZrCo alloy metal of 1241g from SAES Getters was used for the storage of hydrogen gas. The activation of ZrCo alloy metals was carried out at 500℃ for 5 hours. And the powderization of ZrCo alloy metal was repeated 4 times for $ZrCoH_{1.0}$. The hydriding & dehydriding on ZrCoHx(x=1.0, 1.5, 1.8, 2.0) were performed. The data of hydriding and dehydriding were collected, stored and analyzed by using Lapview 8.2. The temperature characteristics of ZrCo hydride and trays were also analyzed.

Fig. 1. A 260L tank and data acquisition system

3. Results and Discussion

Fig. 2 shows the temperature profiles of ZrCo hydride. The temperatures of ZrCo hydride show increasing trend due to exothermic reactions as powderization proceeds except the first powderization process. The temperature of first powderization process was much higher than that of other powderization processes owing to the intentional heater operation for ZrCo surface activation. Fig. 3 shows the temperatures of the middle tray. The temperature of the middle tray also shows increasing trend due to exothermic reactions except the first powderization process.

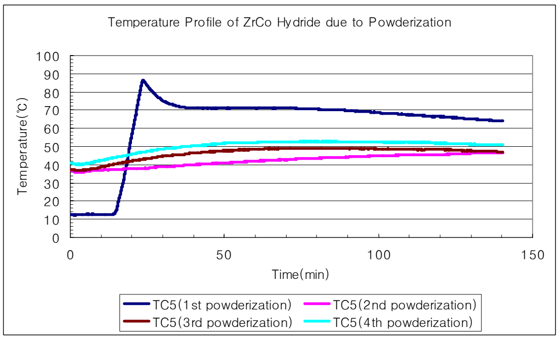

Fig. 2. Temperature profiles of ZrCo hydride

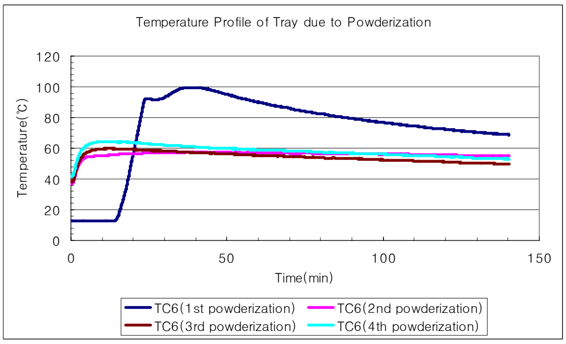

Fig. 3. Temperature profiles of the middle tray

Fig. 4 shows temperature profiles of ZrCo hydride for different hydrogen stoichiometries (ZrCoHx: x=1.0, 1.5, 1.8, 2.0). The temperature profiles of ZrCo hydride shows increasing trend due to exothermic reactions. Fig.5 shows temperature profiles of the middle tray due to hydrogen quantity variations (ZrCoHx: x=1.0, 1.5, 1.8, 2.0). The temperature profiles of the middle tray shows also increasing trend due to exothermic reactions. Fig. 6 shows temperature profiles of the upper, the middle and the lower tray (ZrCoHx: x=2.0). The temperatures of the upper tray (ZrCoHx: x=2.0) were the highest of all the trays. The temperatures of the middle tray (ZrCoHx: x=2.0) were the lowest of all the trays.

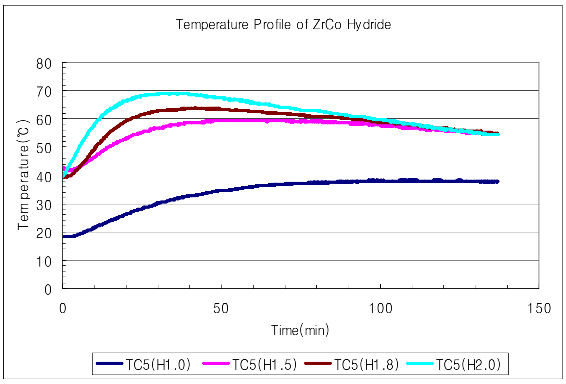

Fig. 4. Temperature profiles of ZrCo hydride (ZrCoHx: x=1.0, 1.5, 1.8, 2.0)

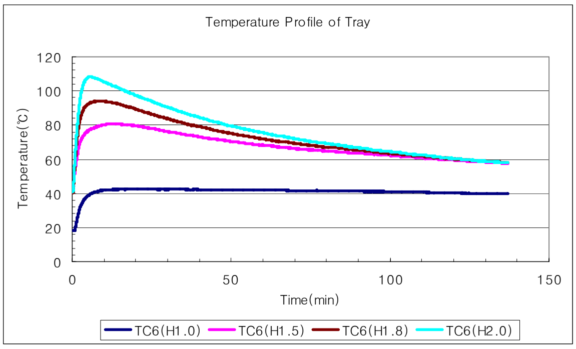

Fig. 5. Temperature profiles of the middle tray

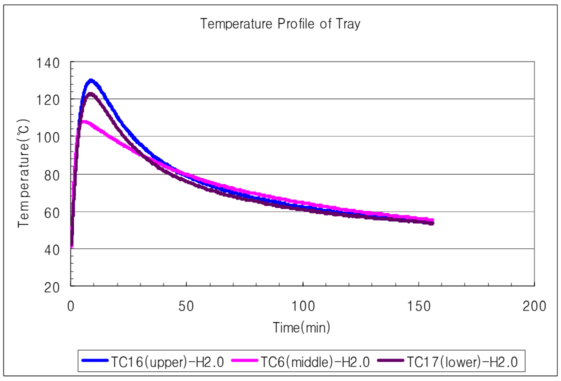

Fig. 6. Temperature profiles of the trays

4. Conclusions

The temperatures of ZrCo hydrides and the middle tray show increasing trend due to exothermic reactions. The temperature profiles of ZrCo hydrides also show increasing trend. The temperatures of the upper tray (ZrCoHx: x=2.0) were the highest of all the trays. The temperatures of the middle tray (ZrCoHx: x=2.0) were the lowest of all the trays. Based on this study, the following is going to be carried out. Further test items are the measurement of recovery rate, a delivery rate, and in-bed tritium accountancy

Acknowledgement

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