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Tritium release behavior from neutron irradiated FLiNaBe mixed with Ti

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INTRODUCTION: FLiNaBe is a promising liquid blanket material of a deuterium – tritium fusion reactor due to chemical stability, low MHD effect and low melting point. Since hydrogen solubility in FLiNaBe is quite low, one concern is permeation loss of bred tritium in transport process to the tritium recovery system. In order to increase effective solubility for tritium, the addition of Ti powder has been proposed [1]. The understanding of tritium release behavior from FLiNaBe is an important issue in the design of fuel recovery systems and radiation safety measures. However, the tritium release behavior from FLiNaBe mixed with Ti is not sufficiently understood. In this work, solid-state samples of FLiNaBe were irradiated by neutrons in Kyoto University Research Reactor. Ti powder was mixed in the irradiated FLiNaBe and tritium release behavior from the FLiNaBe with Ti by heating to 600 °C was observed in Kyushu University.
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EXPERIMENTS: FLiNaBe prepared by the present authors are packed in quartz tubes with vacuum. The quartz tubes were packed in polyethylene capsules and irradiated by neutrons with 5.5×10^{12} $cm^{-2}\cdot s^{-1}$ in flux and 5 minutes in irradiation period. After neutron irradiation, the samples were transported to Kyushu University for tritium release experiments. The schematic diagram of the experimental apparatus is shown in Fig.1. The irradiated sample was put in a Mo crucible, and it was installed in the quartz reaction tube. The sample was heated by an electric furnace to 600 °C in Ar gas flow. The water soluble tritium such as tritiated water vapor (HTO) and tritium fluoride (TF) and gaseous tritium (HT) were separately collected in water bubblers. Ti power was mixed in the irradiated FLiNaBe with 5 wt% and the similar experiment was conducted.
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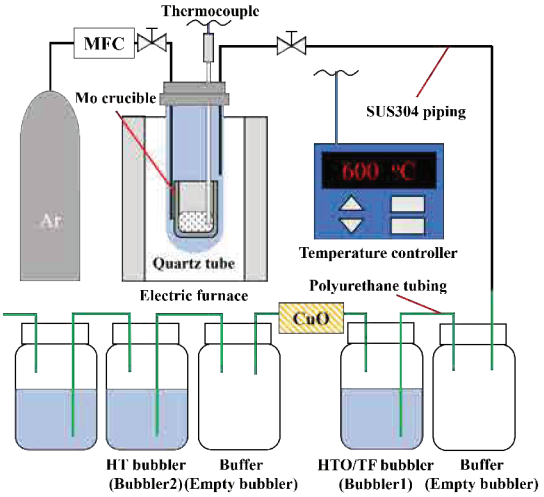

Fig. 1. Experimental apparatus.

RESULTS: Most of tritium was released in water-soluble chemical form. Fig.2 shows the cumulative amount of water-soluble tritium released from neutron irradiated FLiNaBe and FLiNaBe mixed with Ti powder. As this figure shows, the amount of tritium released from the FLiNaBe with Ti was smaller than that from the FLiNaBe. This result clearly indicates that the amount of tritium released in the gas phase from FLiNaBe can be largely suppressed by mixing Ti. At temperatures below 500 °C, tritium was effectively absorbed and retained in Ti powder.
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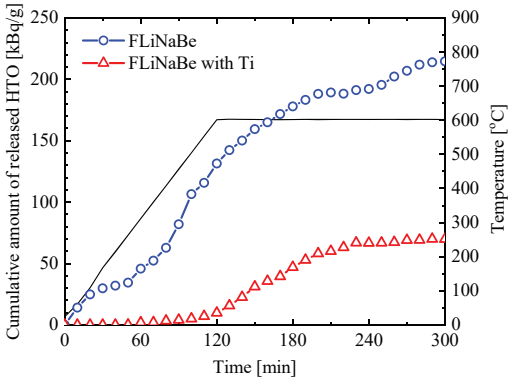

Fig. 2. Cumulative amount of water-soluble tritium released from FLiNaBe and FLiNaBe with Ti powder.

REFERENCES: [1] A. Sagara *et al.,* Fusion Eng. Des., **89** (2014) 2114–2120.