

### §38. Study on Design and Experiment of Tritium Recovery System from Blanket of Falling Liquid Layer of Laser Fusion Reactor

Fukada, S., Edao, Y. (Kyushu Univ.),  
Norimatsu, T. (Osaka Univ.),  
Sagara, A.

Koyo is a concept for commercial laser fusion reactor designed by Osaka Univ. D-T solid pellets are injected into a chamber, and D-T burning due to inertial fusion reaction is induced with intense laser irradiation. In order to avoid heavy neutron irradiation damage and to produce T, liquid wall concept of falling liquid  $\text{Li}_{17}\text{Pb}_{83}$  eutectic alloy is adopted. LiPb is selected because of low vapor pressure, low T solubility and comparatively easy T recovery. LiPb works as a protection film of the chamber wall and a T breeder through the n-Li reaction. The net power is expected 1GWt and the T production rate is 1.5MCi/day. Tritium and heat are simultaneously recovered from the outside LiPb loop. The high T recovery ratio from the loop and the low T permeation rate through heat-exchanger walls are inevitable. The allowed T leak rate is around 10Ci/day.

In order to design the recovery apparatus of T and heat from the LiPb loop, correct data of T solubility, diffusivity and permeability are necessary. In the present study, their data are determined by means of a permeation method [1-5]. The results determined in the present study, which are determined in the operating temperature of the laser fusion reactor, are correlated in **Figs. 1 and 2**. The isotope effects in solubility and diffusivity are correlated in terms of the harmonic oscillation model and the zero-point energy in the solution site surrounded by Li and Pb atoms. The corresponding values for T can be estimated using the zero-point energy at the solution site and the saddle-point site.

The demanded simultaneous recovery rates of tritium and heat can be achieved by the system illustrated in **Fig. 3**. The conditions of temperature, the T concentration in LiPb and steam flows, the flow rate and the area of heat exchanger are estimated. The balance of T and heat is estimated using the mass-transfer parameters.

- 1) S. Fukada, Y. Edao, A. Sagara, Fusion Engineering and Design, in printing as a proceeding of ISFNT-9.
- 2) Y. Edao, H. Noguchi, S. Fukada, Fusion Engineering and Design, in printing as a proceeding of ISFNT-9.
- 3) Y. Edao, S. Fukada, H. Noguchi, et al., Fusion Science and Technology, 56 (2009) 831-835.
- 4) Y. Maeda, S. Fukada, Y. Edao, Fusion Science and Technology, 54 (2008) 131-134.
- 5) S. Fukada, Y. Edao, Y. Maeda, T. Norimatsu, Fusion Engineering and Design, 83 (2008) 747-751.

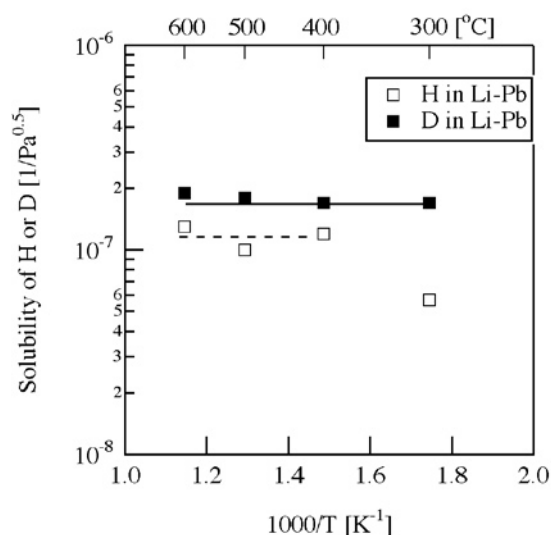


Fig. 1 H or D solubility in  $\text{Li}_{17}\text{Pb}_{83}$

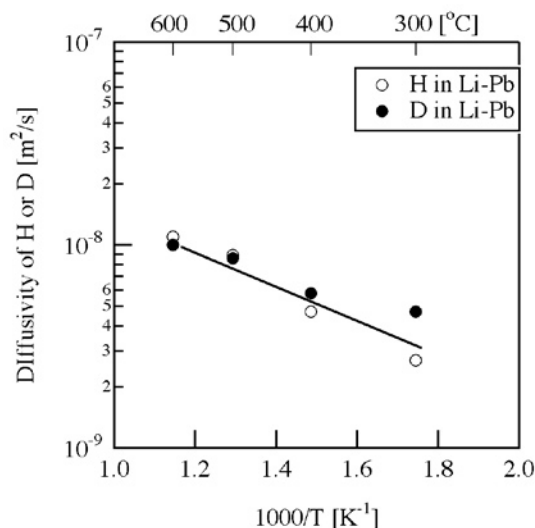


Fig. 2 H or D diffusivity in  $\text{Li}_{17}\text{Pb}_{83}$

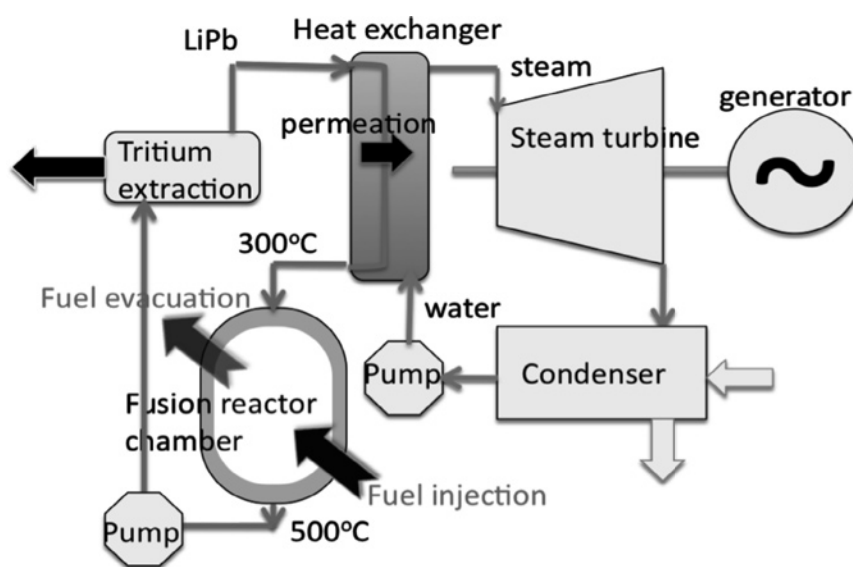


Fig. 3 LiPb and steam loops for Koyo laser fusion reactor