Progress on A-FNS design and R&D
(2) Progress on R&D for liquid lithium target loop of A-FNS

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In the IFMIF/EVEDA project, 6 tasks of R&D for liquid lithium target loop have been implemented in collaboration with Europe since Nov. 2021 to solve the residual common issues based on the previous flame work until 2015. The most important task is to develop lithium purification, and the plan and progress is mainly presented.

Keywords: A-FNS, IFMIF/EVEDA, lithium target, lithium loop, lithium purification

1. Introduction

The Fusion Neutron Source A-FNS, which generates high energy neutron by reaction between deuteron and lithium, is planned to be constructed in Rokkasho to acquire a variety of irradiation data on fusion DEMO reactor materials. It is necessary to develop the purification system in the liquid lithium loop, to evaluate the erosion/corrosion (E/C) behavior of the target, and to research the safety lithium handling. We have started and are implementing the R&D for the liquid lithium target loop in collaboration with Europe since Nov. 2021 under the IFMIF/EVEDA project [1,2], where 6 tasks are addressed as common issues between A-FNS and IFMIF/DONES, namely .(1) the validation of lithium purification system, (2) the lithium target diagnostics, (3) the material analysis used in the IFMIF/EVEDA Lithium Test Loop (ELTL), (4) the stabilization method of used lithium including tritium, (5) countermeasures against lithium fire, and (6) impurity monitors for lithium.

2. Progress on R&D for Liquid lithium Target Loop

About the task (1), a pilot plant for lithium purification validation experiments has been designed as basically 1/10 scale with fixing the superficial velocity to be the same as A-FNS. Figure 1 shows a bird-view of the pilot Li purification plant. The fabrication of this system will be finished on the end of 2023. About the task (3), a preliminary E/C model in the nozzle of target assembly (TA) had been made. Based on this model, the E/C behavior in the nozzle of ELTL have been evaluated by metallurgical observation, where at most 7 μm of E/C thickness could be estimated. From this result, the E/C limit in the nozzle of TA is suggested to alleviate from 1 μm (tentative determined limit values for IFMIF) to 7 μm. About the task (5), a lithium fire experimental set-up had been designed and fabricated, and some experiments have been performed, where no ignition and rapid ignition of lithium could be confirmed under dry and humid air, respectively. About the task (6), the measurement technique of hydrogen concentration in lithium ($[H]_{Li}$) has been devised with the heavy water dissolving method [3] and is under developing. As a preliminary result, 0.14±0.2a% of $[H]_{Li}$ could be measured using the lithium sampled from ELTL and agreed well with that estimated from hydrogen solubility at 250 °C of 0.13a%.

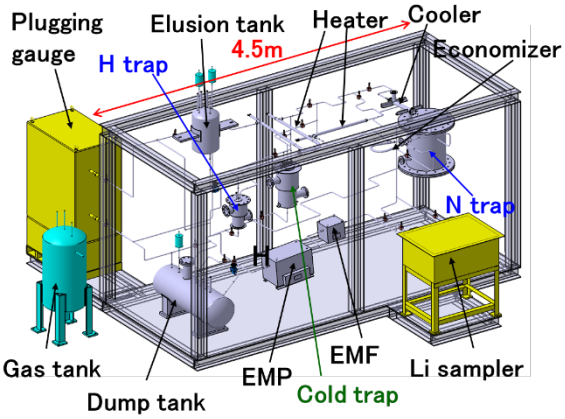

Fig. 1 A bird-view of the pilot Li purification plant.

[1] J. Knaster et al, Nucl. Fusion 57 (2017) 102016.
[2] P. Cara et al, “IFMIF/EVEDA Project: Achievements and Outlooks beyond 2020”, presented at FEC 2021.
[3] K. Okuno and H. Kudo, J. Nucl. Mater., 138 (1986) 31-35.