Progress on A-FNS design and R&D
(3) Dose rate assessment due to activated depositions in Li loop of A-FNS

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The A-FNS is designed to generate the neutrons due to the reactions between deuterium and Li. The backplate behind the Li target is highly activated due to the neutrons generated from the Li target. In this study, the activation of the backplate and the dose rate due to the activated erosion/corrosion products from the backplate were evaluated as an activity of BA Phase II in the IFMIF/EVEDA project.

Keywords: activated deposition, F82H, activation calculation, liquid lithium loop, dose rate

1. Introduction

The Fusion Neutron Source A-FNS aims to generate high energy neutrons corresponding to ones generated by DT fusion reaction using the nuclear reactions between deuterium and Li. In the Li target system, the liquid Li flows on the concave backplate (BP) made of a reduced activation ferritic/martensitic steel F82H. The BP is inevitably activated due to the irradiation with the neutrons. The Li flow enhances the erosion and corrosion of the BP, which lead to contamination of the liquid Li with the activated products and deposition of activated products onto the Li loop components. The evaluation in the dose rate due to the activated erosion/corrosion products has not been completed yet. In this study, the radioactivity in the BP and the dose rate due to the activated products were evaluated.

2. Method

The neutron flux at the BP was calculated by using the Monte Carlo calculation code, MCNP6.2, and the neutron generation source code, McDeLicious-17. The activation in the BP and the dose rate were calculated using the inventory calculation code, FISPACT-II. The erosion/corrosion product weight was calculated as 0.079 g with the beam footprint and the erosion/corrosion tolerance value, 1 μm, in the IFMIF design. In this calculation, one year operation was assumed.

3. Result

The contact γ-dose rate due to the activated product is shown in Fig. 1. Fig. 2 shows the dose rates as a function of the distance when the activated erosion/corrosion products are assumed to be deposited as the point source (0.079 g). The thicknesses of the Li loop components are expected to be several dozen centimeters with heat insulations, and the dose rate from 0.3 m away from the source is 2.1 × 10^{-1} Sv/h. The dose rate is expected to reduce incorporating the realistic conditions such as the availability (50% in A-FNS design), the time-dependence of the activation and erosion/corrosion, and the shielding effect by the component material.

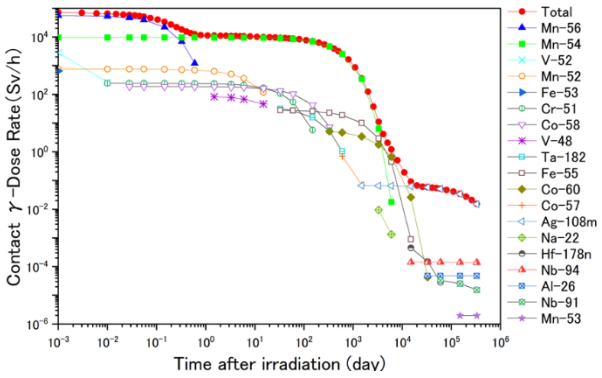

Fig. 1 Total contact γ-dose rate and the dose rate due to the dominant nuclides vs cooling time. Top 5 nuclides are plotted in each time.

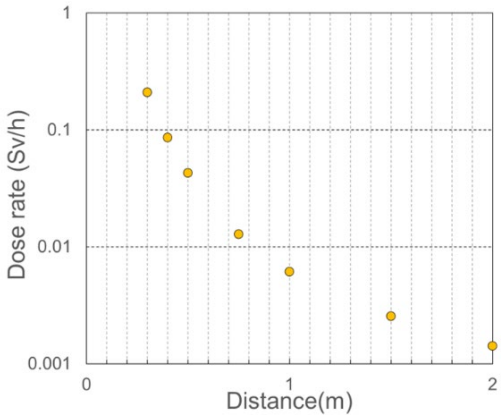

Fig. 2 Dose rates around the point source as a function of the distance 1 day after the 1-year operation.