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P3.157 Fusion neutron generation and two-dimensional neutron measurement by imaging plate detector

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This research aims to develop a two-dimensional analysis of neutron flux within the blanket modules by using a compact discharge device as neutron source and imaging plates for detector. Neutron detectable imaging plate is composed photostimulated luminescence (PSL) material and converter such as gadolinium, allowing a high spatial resolution neutron radiography in a wide dynamic range of 10^5 with high sensitivity even at the neutron production rate of 10^6 n/s level, when exposed for a several hours. Previous researches showed that feasibility of a quantitative measurement by the neutron imaging plate as PSL intensity measured in a read out process is proportional to number of neutrons on the converter. In the experiment, deutrium–deutrium fusion neutron (2.45 MeV) is generated from a discharge-type fusion neutron source and then blanket samples are irradiated to measure the neutron transport. Neutron production rate from the source was enhanced by coating Ti thin film on the cathode. Li targets (Li2CO3 powder and LiPb plates) and thin Au foils were placed in front of the imaging plate. Neutron image was read out by photostimulation using red visible light. Simulation of neutron flux distribution in the experimental system was performed by Monte Carlo n-particle (MCNP-5) transport code with FENDL-2.1 library and then compared with the neutron image. Calibration of PSL into neutron flux was carried out by using 252Cf neutron source. After irradiation for approximately two hours with neutron production rate higher than 10^6 n/s, neutron image was successfully obtained. The image showed high PSL intensities in area where more neutron is irradiated, while decreased PSL intensities were observed behind the LiPb block caused by neutron capture by Li-6, in consistent with the simulation result. Neutron transport analyses measuring two-dimensional neutron distribution in a blanket module are experimentally verified.

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