§3. A Dual Type Ionization Chamber for Monitoring n-X Mixed Fields

Kodaira, J., Obayashi, H., Sakuma, Y., Miyake, H., Yamanishi, H.
Yamamoto, T. (Inst. Sci. & Ind. Res., Osaka Univ.)

In the vicinity of nuclear fusion experiments, mixed radiation fields X-rays and neutrons are expected to arise as burst-like pulses according to plasma shots. It is therefore important from radiation protection point of view to have a monitoring sensor effective for real time and separate measurements of X and n components with a good dynamic range.

A dual type ionization chamber system has been developed for dosimetry use of n-X mixed fields. This is composed of a pair of cylindrical vessels of the same size and shape (80mmϕ × 200mm; 3mm thick stainless steel), one containing ^{3}He gas and the other ^{4}He. Since ^{3}He is sensitive to both neutrons and X-rays, while ^{4}He only to X, it will be possible to find out the neutron contribution by subtraction of the signal.

The neutron signals from ^{3}He are due to a capture process which is high in sensitivity for thermal neutron and low for fast neutron. It is important to select a suitable thickness of moderator. A polyethylene moderator gives reducing energy, shielding and reflecting for neutron. The response of detector depends upon the shape of moderator. We are interested in neutron energies up to a few MeV. The mean energy of ^{252}Cf neutron being about 2 MeV, it is suitable for testing moderator of our detector.

The geometry of ^{252}Cf source irradiation experiment was arranged as shown in Figure 1. Polyethylene blocks (50mm × 100mm × 200mm) were put on between ^{252}Cf source and ^{3}He ionization chamber of which distance was 426mm.

Figure 2 shows relationship between thickness of moderator and ^{3}He chamber response. When 50mm thick moderator was put on, the sensitivity was increased. There is not much difference of response between 50mm thick and others.

Cadmium absorbs thermal neutron. "Cd off-on" in Figure 2 means the response to thermal neutron. The sensitivity of ^{3}He chamber for thermal neutron is larger than that for fast neutron.

As a result, it is suggested that the optimal thickness of moderator is 50mm for ^{252}Cf neutron.

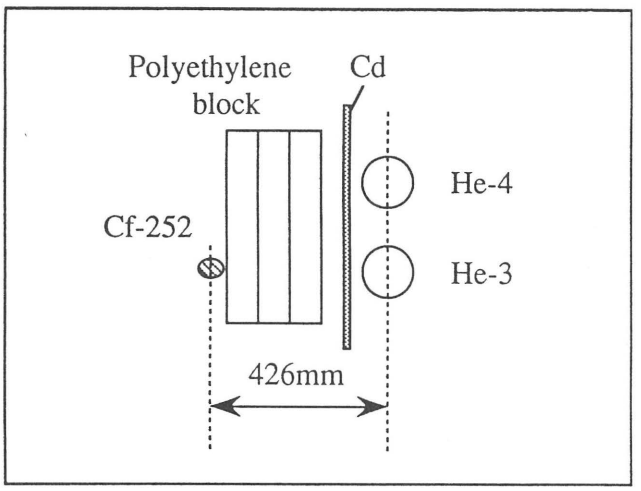

Fig. 1. Geometry of ^{252}Cf source irradiation experiment.

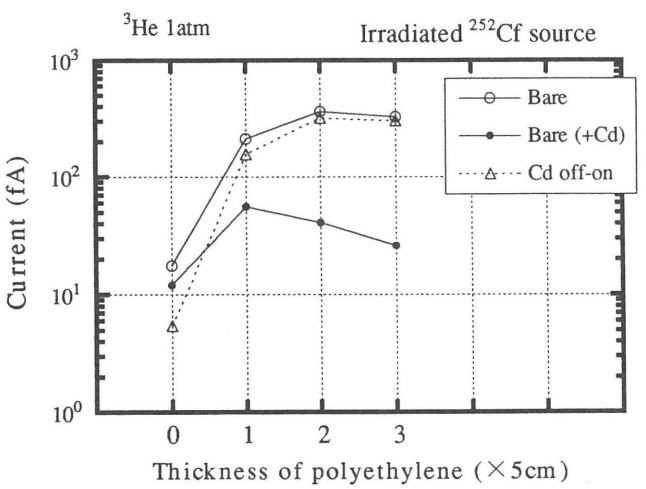

Fig. 2. Effect of polyethylene moderator.