§4. Neutron Induced Luminescence of Window Materials

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For reliable application of optical window materials to fusion plasma diagnostic systems, it is necessary to investigate not only permanent damage but also transient effects of the 14MeV neutron irradiation on window materials. The neutron induced luminescence from the window, for instance, may cause a noise problem for a sensitive photon detecting system with the window.

A photon counting system, composed of a sample holder containing lenses to focus photons from the sample, optical fibers for the photon transmission, a cooled low-noise photomultiplier tube, a grating polychromator and a personal computer, has been developed to measure the 14MeV neutron induced luminescence on window materials.[1] *In-situ* measurements of a small amount of the photon emission in the wavelength region from 350 to 650 nm were successfully performed during 14MeV neutron irradiation for pure and Ge-doped silica, sapphire and other optical samples. Figure 1 shows the wavelength spectra of emitted photons in 14MeV neutron and ^{60}Co gamma-ray irradiation experiments for the same pure silica sample. Table 1 also summarizes the photon emission rate, i.e. the number of emitted photons per unit absorbed energy for the samples.

The efficiency of the 14MeV neutron induced luminescence was determined by the subtraction of the contribution of the induced gamma-ray to the photon emission from the data obtained in the neutron experiments. The efficiency of the 14MeV neutron induced luminescence on the typical pure silica has been found to be 5±3 photons/MeV and one order and a half smaller than that of the gamma-ray induced photon emission. These data should be useful for the estimation of the background level of optical fusion diagnostic systems exposed to 14MeV neutrons. It should be also noted that the results of the present experiments suggest the induced gamma-ray rather than the 14 MeV neutron may be serious for the transient effect like luminescence on optical materials used in a DT fusion reactor.

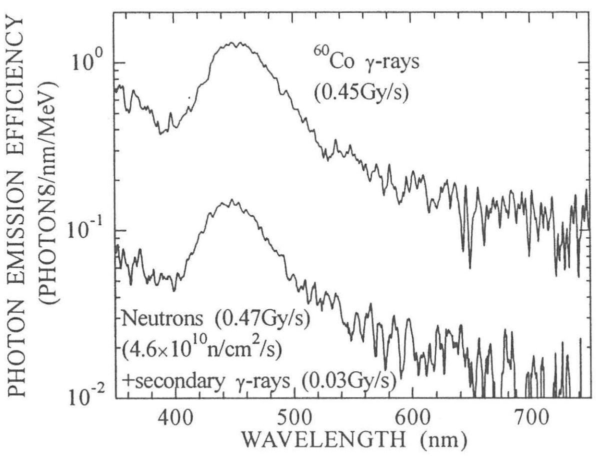

Fig 1. Wavelength spectra of emitted photons in 14MeV neutron and ^{60}Co gamma-ray irradiation experiments for the same pure silica sample.

Reference

[1] F.Sato et al., to be submitted in Rev. Sci. Instrum.

Table 1 Number of emitted photons per unit absorbed energy in the wavelength region from 350 to 650 nm for samples.

Sample	Peak wavelength (nm)	14MeV neutrons +induced γ-rays (photons/MeV)	^{60}Co γ-rays (photons/MeV)
Pure silica	450	17±6	170±60
Ge doped silica	390	83±60	410±140
Sapphire	410	2500±1000	27000±11000
Calcium fluoride	<350, 550	270±110	1300±500
Plastic Scintillator	422	3000±1200	12000±5000