VI-S Study on Compact X-Ray Sources

Electron storage rings are useful and practical devices as x-ray sources because which produce a number of photons because of high electron current and various insertion devices. However, these synchrotron radiation facilities usually occupy large area and cost much. So that there have been many works to investigate compact x-ray sources such as x-ray lasers and free electron lasers. It is also useful to use laser undulator radiation or backward Compton scattering caused by the interactions of electron beams with laser photons, if we provide enough electrons to produce practical intensity of x-rays. RF-photocathode would produce dense electron beam so that it is a useful candidate of a electron source. It is necessary to search good materials as the photocathode for construction of a practical compact x-ray source. Cesium telluride has reported to have a good quantum efficiency, so that we have studied about it.

X-ray sources must be shielded for radiation safety. For constructing effective shields, we need to know how many radiations are yielded from our x-ray sources. We will use high energy electrons to produce x-rays and loss of the electrons cause radiations, it is useful to study radiations in synchrotron radiation facilities in order to estimate the yields radiations from our x-ray sources. We preliminarily measured radiations radiated from a vacuum duct of UVSOR.

VI-S-1 Preliminary Study on Photoemission from Cesium Telluride Irradiated by Polarized Photon

TAKASHIMA, Yoshifumi; KOBAYAKAWA, Hisashi[1]; TAKAGI, Masahiro[1]; KIMURA, Kenichi[1]; SUGIYAMA, Harue[1]; FURUTA, Fumio[1]; NAKANISHI, Tsutomu[1]
([1]Nagoya Univ.)

Cesium telluride is a good candidate for a material to be used as a photocathode for RF-gun because of its high quantum efficiency and long life. The quantum efficiency of the photocathode for polarized photon measured with changing the incident angle of the light gives us important information about the optical constants of the materials of the photocathode.

We measured the quantum efficiency of cesium telluride by using linear polarized photon. Figure 1 shows a sketch of our experimental set up. A Xe lamp was used as a light source. The light from the Xe lamp passed through a monochrometer and a polarizer enter a vacuum chamber in which cesium telluride was evaporated on molybdenum block as a photocathode. The incident angle of the light was changed from –80° to 80°. We rotated the polarizer in order to change the direction of polarization. Figure 2 shows the quantum efficiency for the incident light of 250 nm wavelength. Closed and open circles show the quantum efficiency for the light which is polarized parallel (p-polarization) and perpendicular (s-polarization) to the incident plane, respectively. The quantum efficiency of p-polarization light has peaks at ±65°.

We assume that the quantum efficiency is proportional to (1-R) in order to calculate the optical constants of the photocathode of cesium telluride by using Fresnel formulas. R is reflectivity of the incident light from the photocathode. We obtain preliminary results of optical constants of cesium telluride. The refractive index and the extinction coefficient are 3.17 and 1.01 respectively.

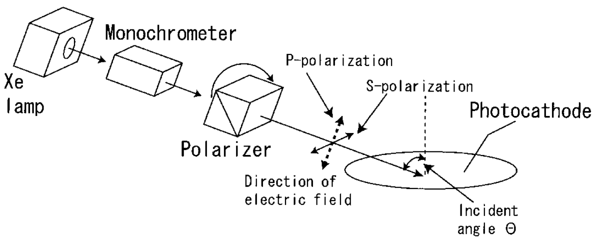

Figure 1. Sketch of experimental set up.

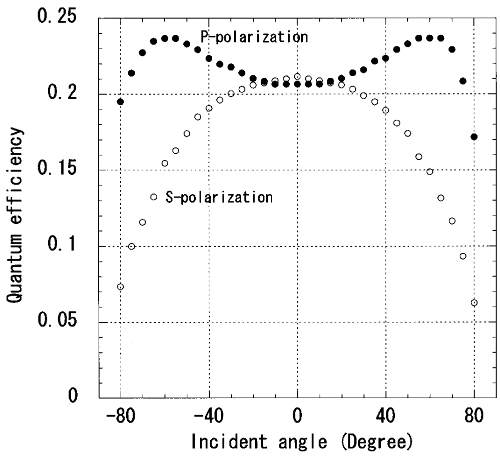

Figure 2. Quantum efficiency of cesium telluride with incident angle of light. The wavelength of the light is 250 nm. Open and closed circles show the quantum efficiency for the incident light which is polarized parallel and perpendicular to the incident plane, respectively.

VI-S-2 Study on Radiation Shielding for Synchrotron Radiation Facilities

TAKASHIMA, Yoshifumi; KOBAYAKAWA, Hisashi[1]; OKI, Sota[1]; YAMAKAGE, Masahiro[1]; TOMIHIRA, Kiyotaka[1]
([1]Nagoya Univ.)

Radiation shielding for synchrotron facilities is to be effective in protecting radiations. In order to design effective shields, we need to estimate how many radiations are generated from a storage ring and penetrate radiation shields.

Electron loss in beam ducts cause considerable stray radiations. Circulating electrons in a storage ring go out of their stable orbit if they interact with residual gases or other electrons. Electrons are also lose when they radiate high energy synchrotron radiations. These electrons are incident on the beam duct and generate electromagnetic showers around the ring.

We measured energy depositions of electromagnetic shower in NaI(Tl) scintillation counter generated by beam loss in a beam duct of UVSOR storage ring. Figure 1 shows experimental setup schematically. The diameter and thickness of the NaI(Tl) are 1 inch and 2 mm, respectively. The detection angles were 40° and 60°. Figure 2 shows pulse height distributions of energy depositions in NaI(Tl) for each detection angles. The energy deposition at 40° is larger than 60° because the incident angle of electrons in the beam duct is smaller than 40° and electromagnetic showers grow toward the incident angle.

For further study, we should measure the energy deposition in NaI(Tl) counter at smaller detection angles than 40° in order to estimate the incident angle of electrons in the beam duct. The information of the incident angle is important to calculate the spatial distribution of the dose around a storage ring. We should also investigate the absolute intensity of electromagnetic shower by comparing experimental results and theoretical calculations in order to estimate yields of radiations precisely for facilities of compact x-ray sources.

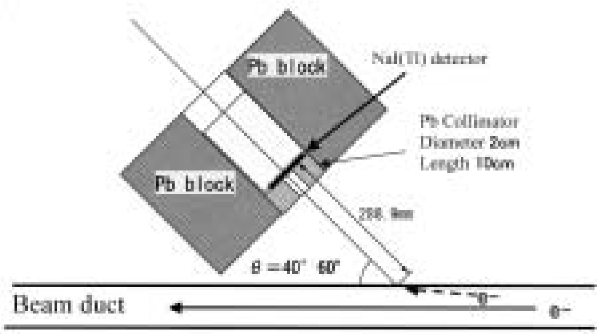

Figure 1. Experimental setup.

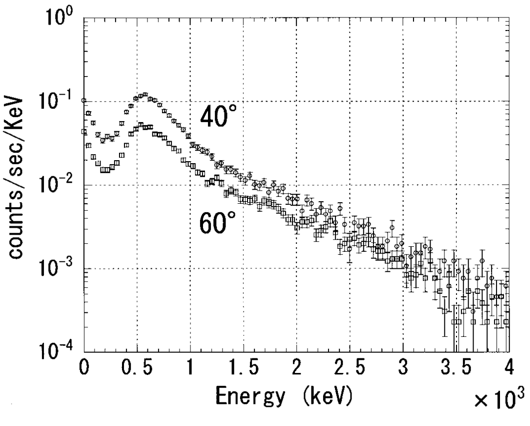

Figure 2. Pulse height distribution of energy deposition in NaI(Tl) detector. Open circles and open squares show the experimental data for detection angle of 40° and 60°, respectively.