Thin-foil I_0 Monitor as an Aligning Tool for the Front-end Slits of the SPring-8 Undulator Beamline

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1. Introduction

SPring-8 standard in-vacuum undulator (λ_u = 32 mm) radiates extremely intensive beam as high as 11 kW total power under the condition of minimum gap operation [1]. In such case, peak heat flux will be in excess of 450 kW/mrad^2. If such intense beam irradiates the beamline component beyond its cooling ability accidentally, it will give rise to a serious problem resulting in vacuum fail. The majority of the radiated power attributes to the waste photons and they mainly distribute off from the axis of fundamental radiation. Elimination of such waste photons using the front-end slits [2-3] helps to operate beamline in safety, even if the undulator gap is set to be minimum. The front-end slits, which consist of the pre slit [2] and the XY-slits assembly [3], have been designed so as to shut off the waste photons without considerable reduction of the fundamental radiation. The axis of the front-end slits, therefore, should be well-aligned to that of the fundamental radiation. In order to align the front-end slits, a thin-foil I_0 monitor and its specific I/V converter (NIM module) have been developed as an aligning tool. Here we describe the design of the aligning tool and its characterization briefly.

2. Design

The detector head of the monitor consists of a thin-foil (graphite or gold) and an electrode to detect the emission of photoelectrons as a photo current. They are held between a couple of insulators and clamped on the arm made of copper tubes. The detector head can be indirectly water-cooled so as to withstand the high intensity beam. According to the ANSYS finite element analyses, the monitor will survive the severe condition, *e.g.* minimum gap operation, in spite of its poor cooling ability, when we supply the cooling water of 1.4 liter/min and set the aperture size to be about 2 mm^2 by the XY-slits assembly. The detector head can be inserted into the beam axis by adjusting the linear actuator manually. The schematic drawing of the monitor is shown in Fig.1.

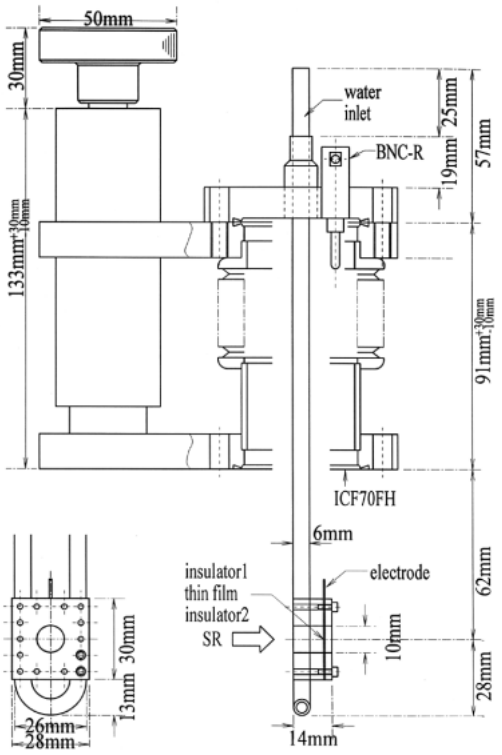
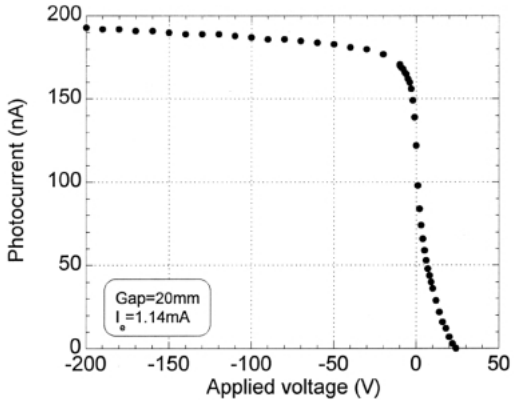


Fig.1 Schematic drawing of the thin-foil I_0 monitor

3. Basic characterization

The monitor is installed between the front-end Be windows and the monochromator. Figure 2 shows the photograph of the monitor installed in the optics hutch. The I/V converter enables us to measure the photo current by means of voltage-force current measurement. Fig.3 shows the applied voltage dependence of the photo current. Usually the measurement is done by applying voltage in the plateau region. The present aligning tool allows us to monitor the relative intensity of direct undulator beam and gives us an opportunity to get information about



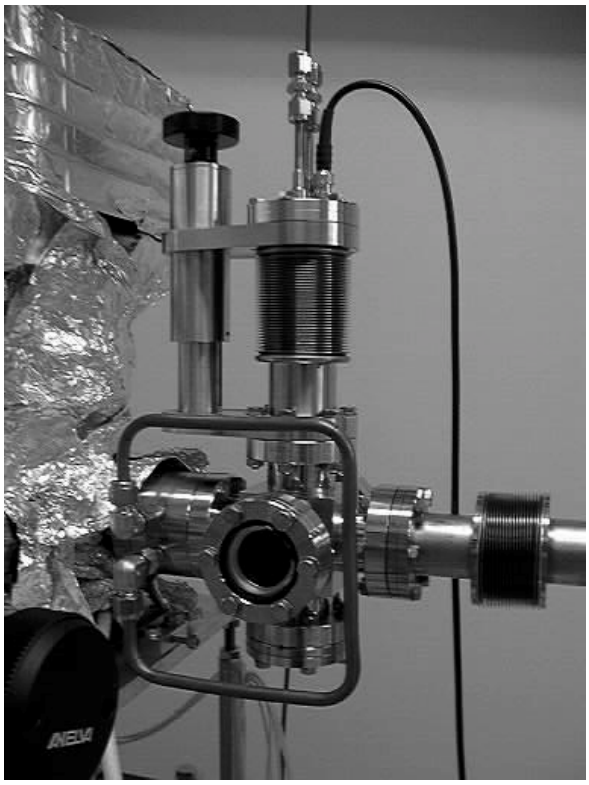


Fig.2 Photograph of the thin-foil I_0 monitor installed in the beamline

Fig.3 Relationship between the applied voltage and the photo current

the spatial distribution of the radiated power of the beam [4]. Figs. 4(a) and 4(b) show the beam profile measured by scanning the pre slit. Both of the actuators of the pre slit are adjusted to their optimum positions. The aperture size and its center of the XY-slits assembly can be also determined using this alignment.

Concerning the capability of this monitor to be used as the I_0 monitor, the relationship between the stored current and the monitor output has been studied as shown in Fig.5, although it is difficult to deduce the absolute intensity of the undulator beam. As can be

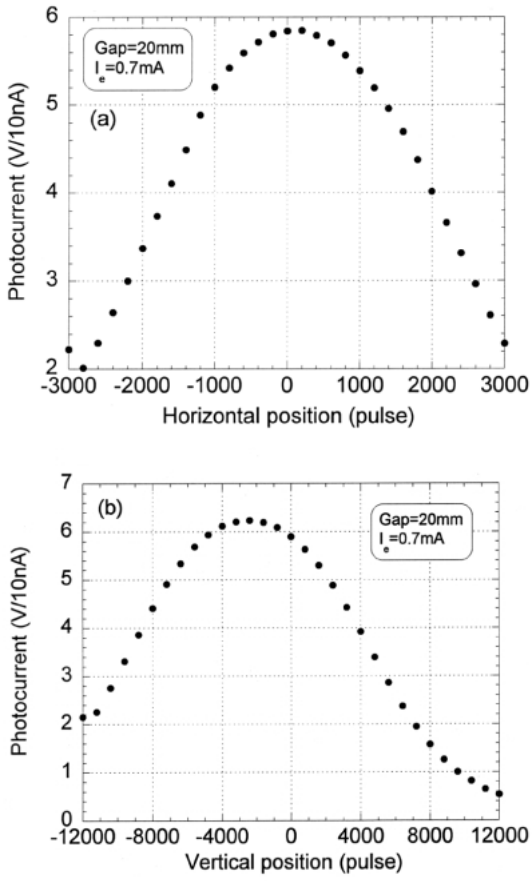


Fig.4 Beam profile measured by scanning the X-stage (a) and Z-stage (b) of the pre slit

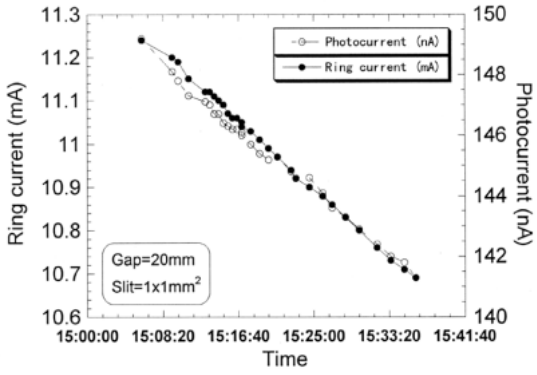


Fig.5 Relationship between the stored current and the monitor output

seen in the figure, monitor output reflects the decay tendency of the stored current. So that a drastic change in the beam intensity due to accidents happened in the front ends, such as a damage of the filter, will be detected.

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