Laboratory Notes

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A shutter–photodiode combination for UV and soft X-ray beamlines

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A fast (~12 ms) shutter for UHV beamlines is described. In the closed position the beam is blocked by an electrically isolated aluminium piece. The total yield photocurrent in this situation can be used to monitor the beam intensity.

Keywords: shutter–photodiode combination.

1. Introduction

In many experiments it is important to be able to shutter the beam. In our work this is to protect radiation-sensitive samples from unnecessary exposure, or for reading out a low-noise CCD detector. Shuttering is often performed using either the beamline's safety shutter or a valve near the experiment. Both of these devices tend to be relatively slow, and frequent use can shorten their lifetime.

Most beamlines also require some form of intensity monitoring. A Samson photodiode (Samson, 1967), where the photocurrent from an aluminium surface is measured, is frequently used. Using the measurements by Day *et al.* (1981), this photocurrent can be converted to photon flux for monochromatic radiation. Of course, the photodiode must intercept the beam, as our shutter does in its closed position.

2. Description of the device

The device, shown schematically in Fig. 1, is based on a bellows-sealed wobble stick on a standard mini-flange. It is used downstream of the monochromator exit slit where the beam is small (<200 μm), and the total power is much less than 1 W. The aluminium piece is attached directly to the wobble stick, which can be actuated by a computer-controlled solenoid. Since the beam is small, a sideways displacement of a few millimetres is sufficient to open or close the shutter. To provide isolation, an electrical feedthrough is used as the stick itself. The photocurrent is monitored by connecting the wobble stick to the negative terminal of a shielded 9 V battery whose positive terminal is connected to an electrometer. The emitted electrons are collected on the walls of the vacuum system, which serves as common ground.

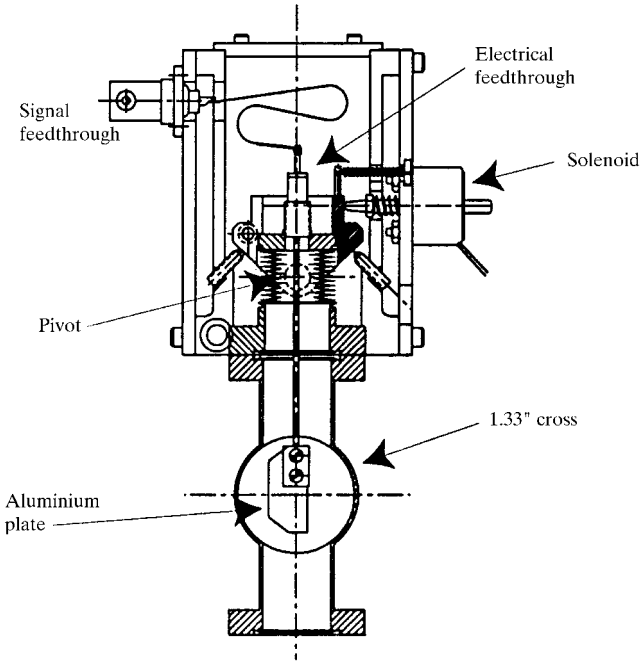

Figure 1
Schematic layout of the shutter–photodiode. The beam direction is perpendicular to the drawing.

The moveable part of the bellows is supported so that it should not collapse from vacuum forces, yet be capable of transverse motion under the action of a spring against an electromagnet. The electromagnet is connected to a custom power supply, which operates under computer control. To assure fast switching, the supply generates an initial output at relatively high voltage, then a lower value to keep the shutter in place without overheating the solenoid.

We have used the device to monitor the beam intensity in normal operations, and also to examine the intensity as a function of wavelength, to verify beamline alignment and monochromator performance.

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