Journal of
Synchrotron Radiation
ISSN 0909-0495

Notes for Authors
Proceedings of the International Symposium on Diffraction Structural Biology (ISDSB 2003)

1. Submission for refereeing

Authors should submit **four copies** of the paper, accompanied by a signed Transfer of Copyright Agreement form (Appendix *A*). Three of the copies should typed in double-spaced format, and one should be prepared in publication-ready format (see Appendix *B*). Authors may also submit a machine-readable copy of the paper to the email address given below. Contributions should conform to the general editorial style of *Journal of Synchrotron Radiation*.

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At the acceptance stage authors will be required to submit an electronic publication-ready copy (see Appendix *B*).

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3.2. Title and authors

The title should be short and informative. The contact author should provide an e-mail address and a fax number. The e-mail address will be used for editorial communications and despatch of electronic reprints.

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The *Abstract* should state concisely the principal results obtained. Ordinarily 100 words will suffice. It should make no reference to tables, diagrams, or formulae contained in the body of the paper. Literature references in an *Abstract* are discouraged. If a reference is unavoidable, it should be sufficiently full within the *Abstract* for unambiguous identification, *e.g.* [Smith (2002). *J. Synchrotron Rad.* **9**, 21–31].

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The International System of Units (SI) is used except that the angstrom (symbol Å, defined as 10^{-10} m) is generally preferred to the nanometre (nm) or picometre (pm) as the appropriate unit of length. Recommended prefixes of decimal multiples should be used rather than '$\times 10^{n}$'.

3.5. Figures

Figures should be prepared using one of the file formats listed in §3.1. Each diagram must also be provided in 'hard-copy' form, as detailed upon submission. Colour or greyscale figures should be provided as glossy prints; laser printer or photocopier output will generally be unsatisfactory for colour reproduction. Multiple colour and grayscale figures are accepted, but they should be printed within one page. Inclusion of colour will be at the discretion of the Editor.

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Tables produced in Word should be prepared using the Word table editor.

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Collaborative Computational Project, Number 4 (1994). *Acta Cryst.* D**50**, 760–763.
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(1) The paper should be submitted according to the ISDSB 2003 Notes for Authors. The publication-ready electronic version will not be needed until your paper has been **accepted** by the Editor.

(2) The maximum length of publication-ready copy permitted for these proceedings is **four** pages.

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Layout details

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		WORD template styles
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Authors:	**10 pt bold Arial or Helvetica**	IUCr author section
Affiliations:	*9 pt oblique Arial or Helvetica*	IUCr affiliation text
Abstract:	9 pt Times Roman	IUCr abstract
Keywords:	**8 pt bold Arial or Helvetica**	IUCr keywords
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Level 1:	**8 pt bold Arial or Helvetica, aligned left**	IUCr heading 1
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Text:	9 pt Times Roman	IUCr body text
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(7) When the publication-ready copy has been approved by the Editor, it will be forwarded to the Editorial Office in Chester for publication.

Design and performance of a multilayered mirror monochromator in the low-energy region of the VUV

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For the energy region from tens to hundreds of electron volts, the multilayered mirror (MLM) monochromator has never been realized due to the difficulty of reducing the background noise of the total reflection component, in spite of its useful… synchrotron radiation experiments. In this work, a… type MLM monochromator equipped with… been designed on the basis of t… driving system and of Mo/… has been evaluat… shown th… with an… practical … backgroun…

Keywords: n… …layered mirror monochromators.

1. Introduction

Studies of synchrotron-radiation-stimulated processes such as etching and chemical vapour deposition (CVD) began about 12 years ago (Urisu & Kyuragi, 1987) and are still attracting much interest from many researchers. The vacuum ultraviolet (VUV) photons in synchrotron radiation can excite almost all the electronic states of molecules, so a large variety of chemical reaction channels different from that in the usual thermal-CVD are expected to be opened by synchrotron radiation irradiation. In particular, core electrons, which cannot be excited using lasers, are efficiently excited by the VUV photons in synchrotron radiation. The excitation-energy dependence of a photochemical reaction is important basic data. However, it has not been sufficiently investigated in the VUV region, because of the difficulty in obtaining energy-tunable monochromated light with sufficient photon flux ($>10^{13}$ photons s^{-1}) in the VUV region.

A multilayered mirror (MLM) monochromator is already in use in the high-energy region of the VUV (Barbee *et al.*, 1987). Concerning the low-energy regions, one of the present authors previously tried to use an MLM as a dispersion element in synchrotron-radiation-stimulated experiments. However, this was unsuccessful due to the difficulty in removing the background noise, consisting of total reflection components appearing at less than a few tens of eV. Therefore, in this work, we have designed a double-crystal-type MLM (Golovchenko *et al.*, 1981; Murata *et al.*, 1992) monochromator combined with an appropriate thin-film filter. The design is based on the trial fabrication of MLMs and the driving system for them. We have found that the low-energy background noise is sufficiently removed by using the MLMs at low incident angles combined with a carbon or molybdenum filter.

2. Design of the monochromator and mirrors

2.1. *Monochromator*

We adopted the monochromator driving system proposed by Golovchenko *et al.* (1981). The centres (*A* and *B*, respectively) of the first and the second MLMs are set on the *XY* and *YZ* lines which form a rigid right angle *XYZ*, with the first MLM parallel and the second perpendicular to the *XY*… lines, respectively. A pulsed motor drive sli… of the *XYZ* linearly, keeping the rot… ond mirror fixed. The first mi… ond mirror so that it … the apex … so that … in an … using the … ement is also effec… higher-order photons. The … ecreases as the incident angle to the … mechanical linkage and driving system have … so that the beam incident angle can be adjusted … incident angles as small as possible. The present prototype driving system has successfully covered an incident beam angular range (θ) of 10–80°.

2.2. *MLMs*

The important photon energy region for the experimental investigation of synchrotron radiation processes, especially of the core-electron excitation processes, is from a few tens to hundreds of electron volts. In the present work our attention was focused on the region between 60 and 120 eV, a region for which fairly high reflectivity is obtained by using Mo/Si (for 60−90 eV) and

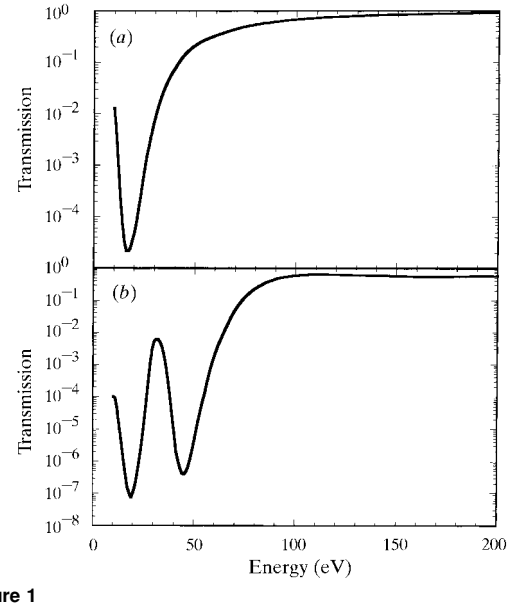

Figure 1
The calculated transmission for (*a*) a 100 nm-thick carbon filter and (*b*) a 100 nm-thick molybdenum filter.

238 mm

88 mm

183 mm

Table 1
Specifications of optical components.

Component		Specifications
Mo/Si MLM	Substrate	Si wafer (40 × 40 mm)
	Number of layers	20
	Period, d	12.5 nm (12.4 nm)†
	Thickness ratio, Mo/Si	3/7 (3.25/6.75)†
	Interface roughness, σ	(0.4 nm)†
Mo/C MLM	Substrate	Si wafer (40 × 40 mm)
	Number of layers	50
	Period, d	7.5 nm (7.9 nm)†
	Thickness ratio, Mo/C	1/1 (5.5/4.5)†
	Interface roughness, σ	(0.4 nm)†

† Values determined by fitting to the observed Cu $K\alpha$ line diffraction curves.

Mo/C (for 85–120 eV) MLMs. This energy region includes the core-electron binding energies of Al (2*s*: 119 eV; 2*p*: 74 eV) and Si (2*p*: 103 eV), which are important materials in semiconductor processes. To reduce the background noise in the low-energy region due to the total reflection, it is necessary to use the MLM at low incident angles. The Mo/Si and Mo/C MLMs were therefore designed so that they could cover the Al 2*s* and 2*p* and Si 2 binding energies in the incident angle range of 10–50° more, the detailed structural parameters have that the reflectivity is high and the re trical. Both Mo/Si and Mo/C meters listed in Table using the Cu Corpora between roughness Porteus, 19 are listed in

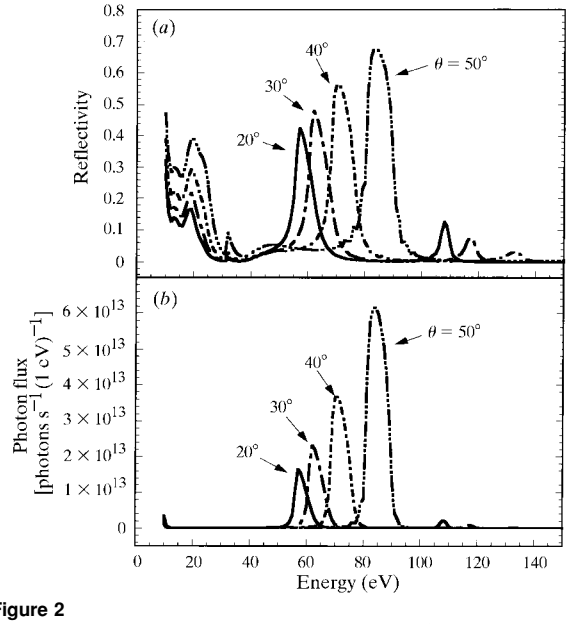

Figure 2
(*a*) Calculated reflectivity for the Mo/Si MLM and (*b*) output photon flux of the monochromator using Mo/Si MLMs plus C filter for a 100 mA ring current and a 16.56 × 12.79 mrad^2 acceptance angle of the pre-mirror, assuming that the monochromator is set up in the beamline BL-4A1 of the UVSOR.

2.3. *Thin-film filters*

The transmission characteristics of the thin-film filter have been calculated for several materials and it has been found that carbon and molybdenum are useful for reducing the background noise at energies below 70 eV. The transmission spectra calculated for 100 nm-thick carbon and molybdenum film filters are shown in Figs. 1(*a*) and 1(*b*), respectively.

3. Performance of the monochromator

The performance of the MLM monochromator, designed as described above, was evaluated by calculating what the basic characteristics, such as output photon flux, resolution, monochromaticity and tuning range, would be if the monochromator were set up as part of the beamline (BL4 e synchrotron radiation storage ring at the UVSO ne, the beam emitted from the bendin is reflected by an elliptical n ngle of 4°. The hori 0 cm and m from 6.1 m bout 0.5 × as calculated for a on the recurrent equation (Spiller, and Mo/C MLMs were first calculated by or parameters listed in Table 1, as shown in Fig. 2(*a*) he Mo/Si case. It is known that extremely large total-reflection components appear at less than 40 eV in the case of Mo/Si.

The output beam photon fluxes calculated for various incident angles are shown in Fig. 2(*b*) for the case of Mo/Si MLM plus C filter. It is clearly shown that the filter drastically reduces the low-energy background noise. It is less than 1% (3%) of the main flux, where the value in parentheses is for the case of Mo/C MLM plus Mo filter. The higher-order photons background noise is less than 4% (0.1%). The calculated photon flux is 1×10^{14} to 5×10^{14} photons s^{-1} (3×10^{13} to 4×10^{13} photons s^{-1}) and the resolution is 5–9 eV (2–4 eV) FWHM. The calculated results are similar to those obtained with a typical undulator. Given that the MLM monochromator can select the photon energy continuously and that the mixing of higher-order photons is small, it is suggested that the present monochromator will be better than an undulator for use in synchrotron radiation experiments. We conclude from this work that the background noise due to the total reflection, which prevented the MLM monochromator from being used in the VUV low-energy region, can be sufficiently reduced by using double-crystal-type MLMs at low incident angles combined with a carbon or molybdenum thin-film filter.

This research was supported in part by a Collaboration Program of the Graduate University for Advanced Studies.

References

Barbee, T. W. Jr, Pianetta, P., Redaelli, R., Tatchyn, R. & Barbee, T. W. III (1987). *Appl. Phys. Lett.* **50**(25), 1841–1843.
Bennett, H. E. & Porteus, J. O. (1961). *J. Opt. Sci. Am.* **51**(2), 123–129.
Golovchenko, J. A., Levesque, R. A. & Cowan, P. L. (1981). *Rev. Sci. Instrum.* **52**(4), 509–516.
Murata, T., Matsukawa, T., Naoe, S., Horigome, T., Matsudo, O. & Watanabe, M. (1992). *Rev. Sci. Instrum.* **63**(1), 1309–1312.
Spiller, J. (1981). *AIP Conf. Proc.* **75**, 124–130.
Urisu, T. & Kyuragi, H. (1987). *J. Vac. Sci. Technol.* B**5**, 1436–1440.

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