Instrumentation and Technique

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Multilayer polarizers in the range of 20 – 40 eV

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Design

Reflection multilayer polarizers were designed for use in the 20 – 40 eV region. Several materials have been chosen for reflector multilayers [1]. Since a polarizance of a multilayer polarizer depends on transparency of materials [2], Si/Mg is the best choice in this region. Around 40 eV SiC/Mg is also the best because of a large difference in refractive indices of SiC and Mg. For a He discharge lamp of a finite angular divergence, a wide angular acceptance is required in a design of a multilayer limiting the period number. First Si/Mg and SiC/Mg multilayers were designed for He-I (21.2.eV) and He-II (40.8 eV) resonance lines, respectively, with the period number fixed at 20. Next a Si/Mg multilayer was designed at 40.8 eV to be expanded in the range of 20 – 40 eV as a tunable polarizer for the use of synchrotron radiation. Designed parameters are listed in Table 1 with measured polarizances and reflectances presented in the next section. Multilayers were fabricated in the magnetron sputtering method by Dr. Y. Kondo, Dr. K. Saito and Mr. Y. Takei, Tohoku Univ.

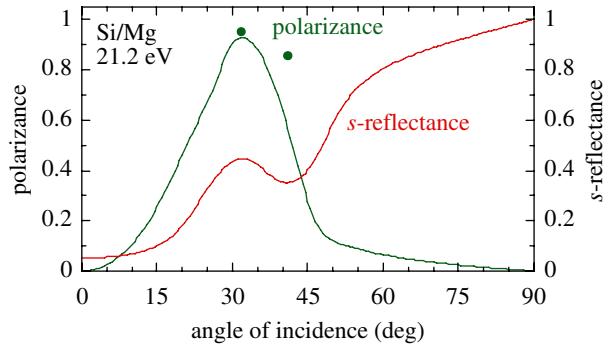

Fig. 1. Polarizance of a Si/Mg multilayer at 21.2 eV.

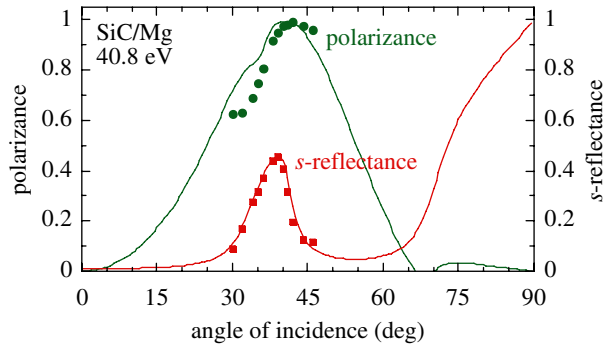

Fig. 2. Polarizance and *s*-reflectance of a SiC/Mg multilayer at 40.8 eV.

Performance

The performances of Si/Mg at 21.2 eV and SiC/Mg at 40.8 eV were checked by means of rotating analyzer ellipsometry at BL5B, UVSOR [2]. The experimental results are plotted in Figs. 1 and 2 with designed values in solid curves. Polarization measurements on a He discharge lamp have been performed using these polarizers [3]. The reflectances for *s*- and *p*-polarizations of Si/Mg at 40.8 eV were measured by the variable polarization reflectometer at BL-12A, PF. The polarizance was obtained from *s*- and *p*-reflectances. The experimental results are plotted in Fig. 3 with designed values in solid curves. A laterally graded Si/Mg multilayer as thick at the both ends as the top and the bottom in Table 1 could make a tunable polarizer combined with an angle of incidence adjustment mechanism.

References

[1] T. Ejima et al., Jpn. J. Appl. Phys. **40**, 376 (2001).
[2] T. Hatano et al., Surf. Rev. Lett. **9**, 587 (2002).
[3] M. Takahashi et al., J. Electron Spectrosc. Relat. Phenom. **130**, 79 (2003).

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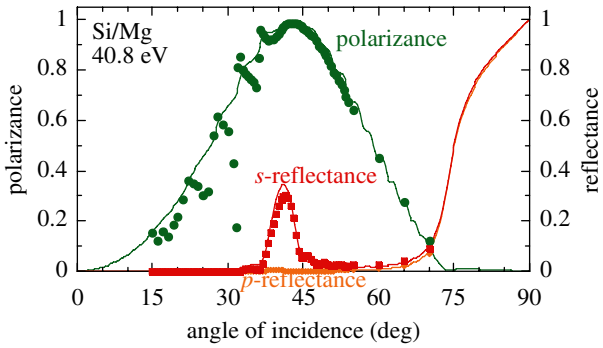

Fig. 3. *s*-, *p*-reflectances and polarizance of a Si/Mg multilayer at 40.8 eV.

Table 1: Design and performance

material	energy (eV)	angle of incidence	period thickness (nm)	polarizance	*s*-reflectance
Si/Mg	21.2 eV	31.5°	52.2	0.96	not measured
SiC/Mg	40.8 eV	40°	21.1	0.98	41%
Si/Mg	40.8 eV	42°	22.2	0.99	29%