

Novel Transmission Gratings with High-dispersion, High-efficiency and Wide Bandwidth I N. Ebizuka^a, T. Okamoto^a, T. Hosobata^a, M. Takeda^a, Y. Yamagata^a, M. Sasaki^b, M. Nishimaki^c, K. Yamamoto^c, Y. Nishio^c, I. Tanaka^d, C. Tokoku^d, T. Hattori^d, S. Ozaki^d, W. Aoki^d, M. Konishi^e, K. Matsubayashi^e, K. Kushibiki^d, K. Motohara^e ^a RIKEN, ^b Toyota Technological Institute, ^c NALUX Co. Ltd., ^d National Astronomical Observatory of Japan, ^e University of Tokyo



Volume binary (VB) grating and trapezoid grating





Reflector Facet Transmission (RFT) Grating





RFT grating is able to achieve high diffraction efficiency by means of internal reflection of a



formed, acicular

changed, the

Since the efficiency of the central order is higher for longer wavelengths, it is supposed that the

2.9

104

39.6

n=1.48

39.6



Cycle etching

generated at the diffraction efficiency of central order is distributed to the nearby orders due to forward scattering caused by surface roughness. 3.9deg. $n_0=1.0$ n=2.47 n=2.47Applied ion milling 32 32 65 Prisms. grating are Without ion milling grism of SWIMS. Applied ion milling Peak efficiency is ~30%.

 n_0

 n_0

VB grating AOI=22.6° 110 5 VB grism with ZnSe AOI VB 22.6°. Which is about 75% of target resolving power of z-J band

0.6





61

Prism array for incident (left) and exit (right) side.





3 6.6

VB grating AOI=30.9°

Silicon

photodetector

prism and prism array for exit side. AOI of VB grating are 30.9°. This value is sufficient for z-J band grism of SWIMS.

VPH grism combined with prism arrays (left and center) and transmission or diffractive efficiency of each optical element (right). Some amount of light intensity from the prism array on the incident side is disappeared.

Summary



• Volume binary (VB) grating: A quartz VB grating has been developed as a successor to the MOIRCS K band VPH grism. A silicon VB grating for SWIMS H-K band is going to develop.

• Trapezoid grating: A resin trapezoid grating was prototyped by replica processing using a silicon mold had performed. As a result of the experiment, the peak efficiency was nearly 30% because the grooves became cloudy upon release from the silicon mold. We plane to improve the method for releasing from the mold.

• RFT grating: A 20 lp/mm RFT grating with hard resin has been prototyped using diamond flycutting processing. It was found that the diffraction efficiency of central order is lost by surface scattering, and the fly-cutting procedure has been improved to reduce scattering.

• Prism array for grism: To reduce the thickness of grism of SWIMS z-J band, a prism array for the grism was prototyped. We are currently developing a prism array using optical glass.