Volume Phase Holographic (VPH) grating

- Test fabrication of volume binary grating with photoresist (KMPR1000, NIPPON KAYAKU Co.Ltd.). Performed by Nanotechnology Platform Program of Toyoda Technological Institute.
- \( \eta = \frac{\text{number of orders}}{\text{number of orders} + \text{number of diffraction orders}} \) up to 0.1. (Baldry, PASP)

Diffraction efficiency of a VPH grating decreases toward higher orders. (Oka, SPIE 5290, 2004)

Volume binary grating

- Test fabrication of volume binary grating with photore sist (KMPR1000, NIPPON KAYAKU Co.Ltd.). Performed by Nanotechnology Platform Program of Toyoda Technological Institute.

Birefringence Bragg binary (3B) grating

- Test fabrication of liquid crystal grating (CITIZN Holdings Ltd.).

Germanium immersion grating

- Fabrication of a germanium immersion grating with size of 30 by 30 by 72 spent ~ 400 hours by means of a nano-precision machine tool and ELID grinding method. (Ebizuka, SPIE 4842, 2003)

Test fabrication of V-grooves on silicon and germanium

- End mill of single-crystal diamond (left), fly-cutting for a silicon substrate by using the end mill (center) and V-grooves on silicon wafer processed by fly cutting of V-bit (right).

Conclusions

- VPH grating achieves high angular dispersion and high efficiency for the 1st diffraction order, as well as versatile for moderate angular dispersion.
- Volume binary grating and birefringence Bragg binary (3B) grating achieve high diffraction efficiency up to 100% for non-polarized light of the 1st diffraction order and of higher diffraction orders (utilized for echelle spectrograph).
- Test fabrication of volume binary grating and 3B grating are performed by Toyoda Technological Institute and by CITIZN Holdings, respectively.
- Quasi-Bragg (QB) grating and quasi-Bragg immersion (QBI) grating, which mirror plates laminated by pressure fusion of gold and chromium, are feasible even for echelle spectroscopy of visible wavelength.
- Silicon and germanium immersion gratings with step-like grooves, which processed by the latest diamond cutting tool, are expected to realize ideal performance for near infrared and mid-infrared, respectively.