Birefringence Volume Grating

$$\eta_S = \sin^2\left\{\frac{\pi(n_{max} - n_{min})t}{\Lambda(n_{max} + n_{min})\sin 2\theta}\right\}$$

$$\eta_P = \sin^2\left\{\frac{\pi(n_{max} - n_{min})t\cos 2\theta}{\Lambda(n_{max} + n_{min})\sin 2\theta}\right\}$$

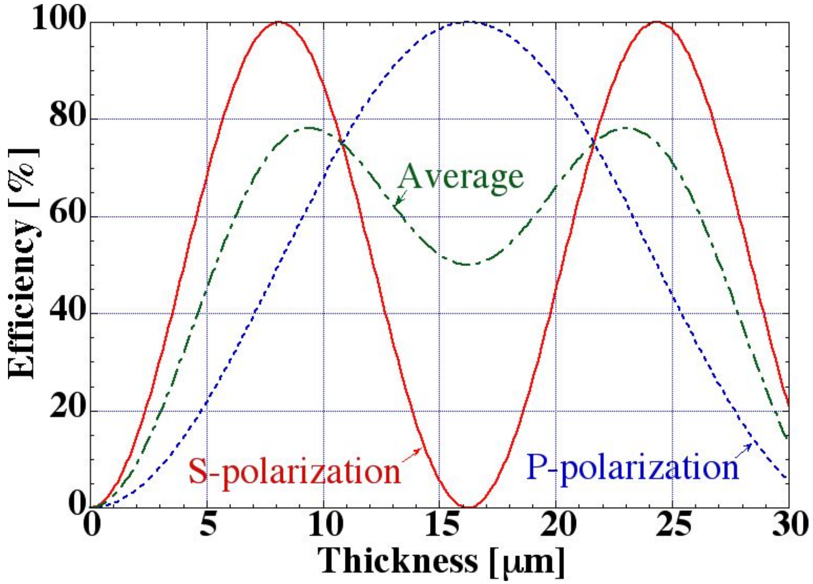
$$\frac{n_{Smax} - n_{Smin}}{(n_{Smax} + n_{Smin})\sin 2\theta_S} = \frac{(n_{Pmax} - n_{Pmin})\cos 2\theta_P}{(n_{Pmax} + n_{Pmin})\sin 2\theta_P}$$

$$\frac{n_{Smax} - n_{Smin}}{(n_{Smax} + n_{Smin})\cdot 2\sin\theta_S\cos\theta_S} = \frac{(n_{Pmax} - n_{Pmin})\cos 2\theta_P}{(n_{Pmax} + n_{Pmin})\cdot 2\sin\theta_P\cos\theta_P}$$

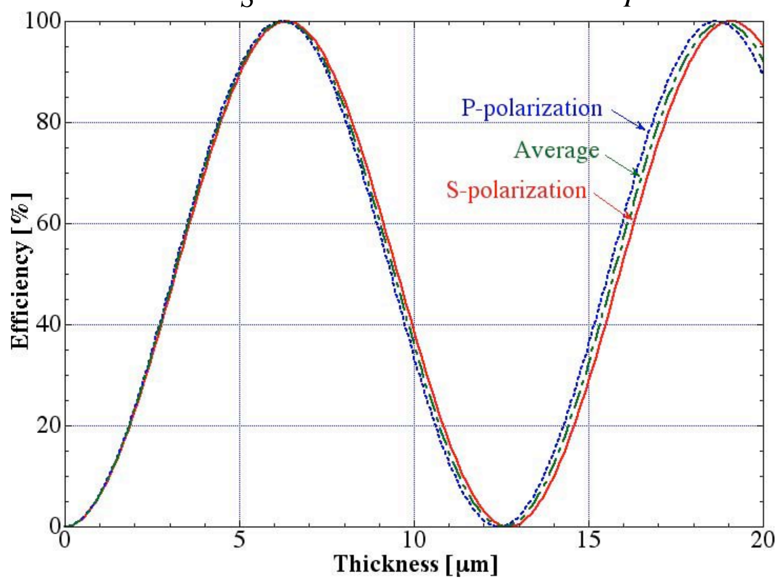
$$(n_{Smax} + n_{Smin})\cdot 2\sin\theta_S = (n_{Pmax} + n_{Pmin})\cdot 2\sin\theta_P$$

Snell's low

$$\frac{n_{Smax} - n_{Smin}}{\cos\theta_S} \cong \frac{(n_{Pmax} - n_{Pmin})\cos 2\theta_P}{\cos\theta_P}$$

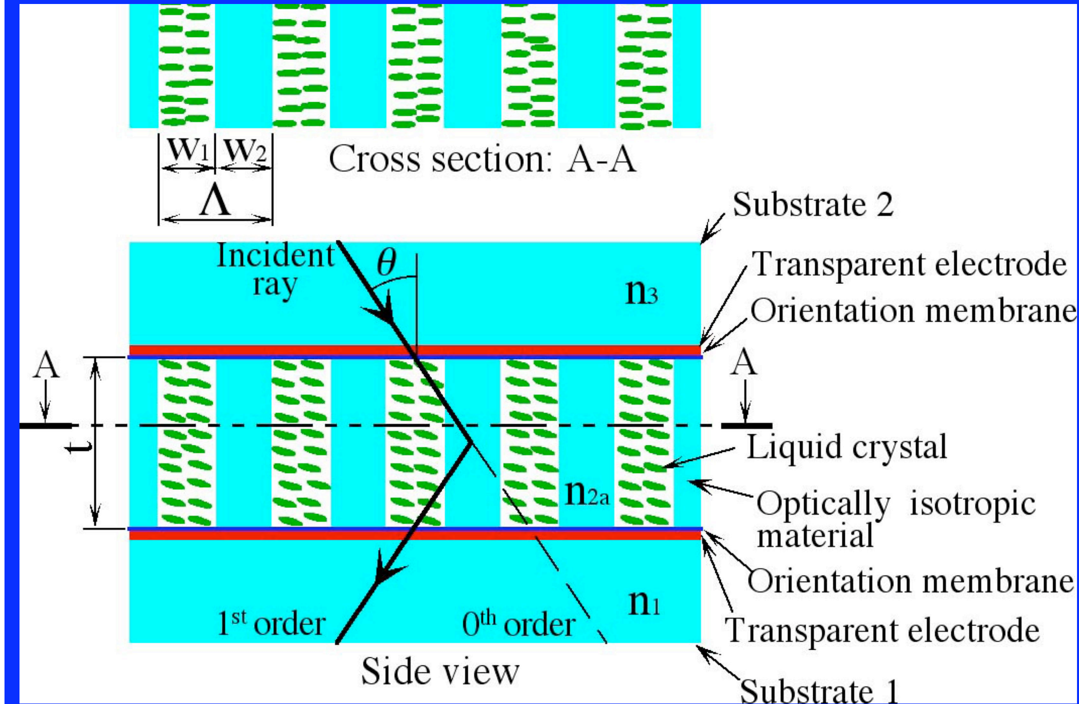


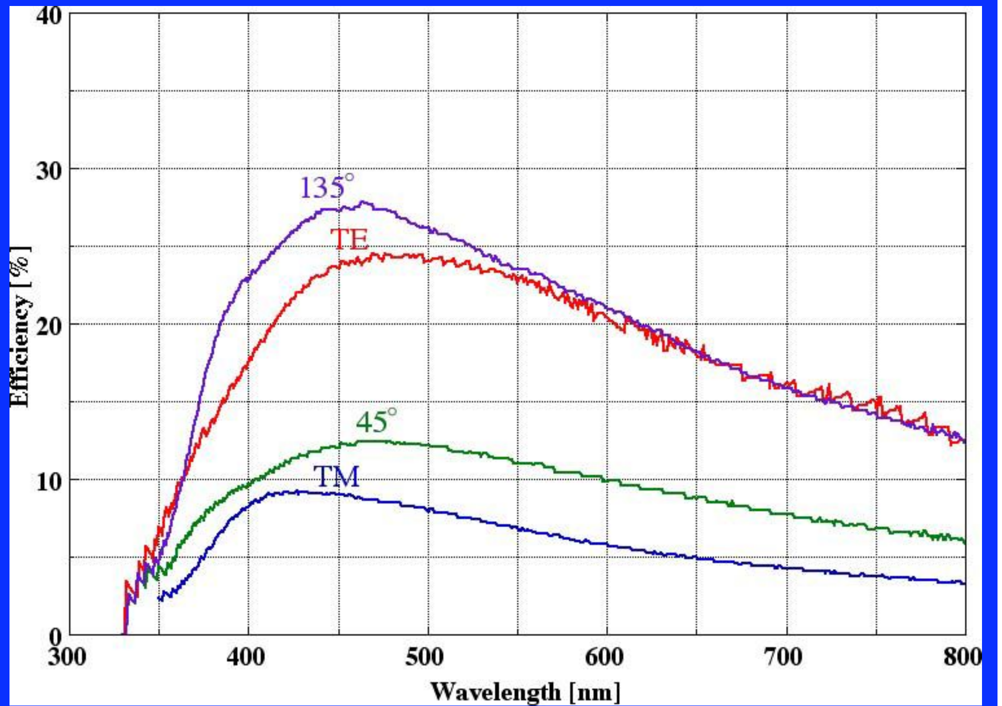
Polarized diffraction efficiencies versus grating thickness *t* of Dicson's VPH grating (Polarizer).
$n_L = 1.46$, $n_H = 1.54$, $\theta_B = 48.5°$.



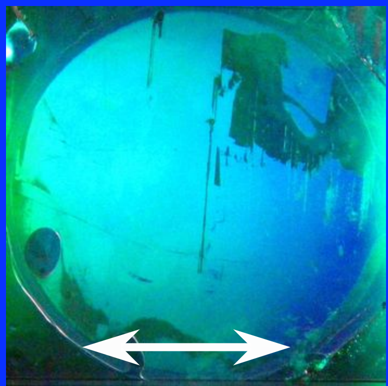
Polarized diffraction efficiencies versus grating thickness *t* of birefringence VPH grating.
$n_L = 1.46$, $n_s = 1.544$, $n_p = 1.60$, $\theta_B = 45°$.

Birefringence Binary Bragg (3B) Grating

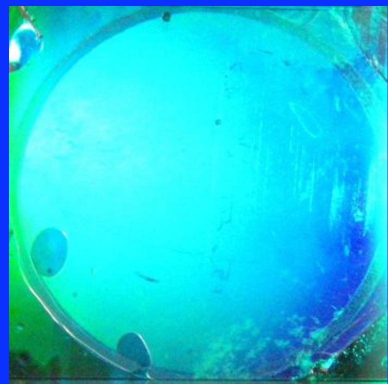




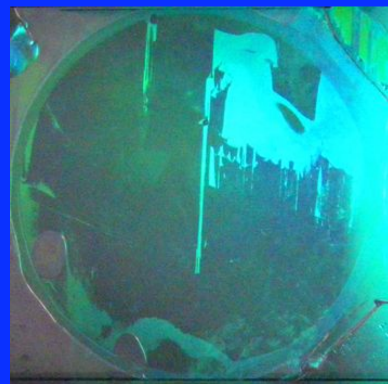
Orientation layer
(Grating vector)



Polarizer angle: 60 ~ 70°



Polarizer angle: 90°

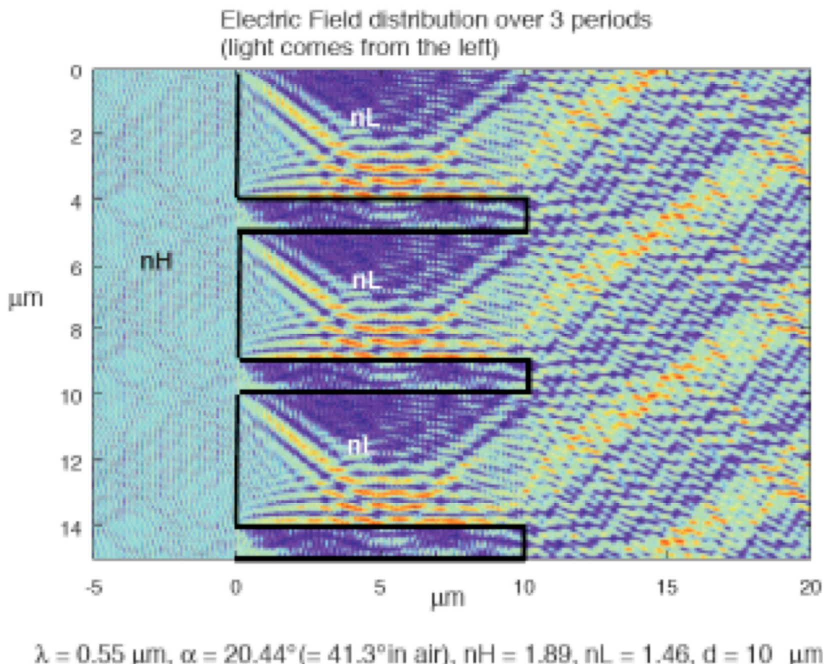


Polarizer angle: -60 ~ -70°

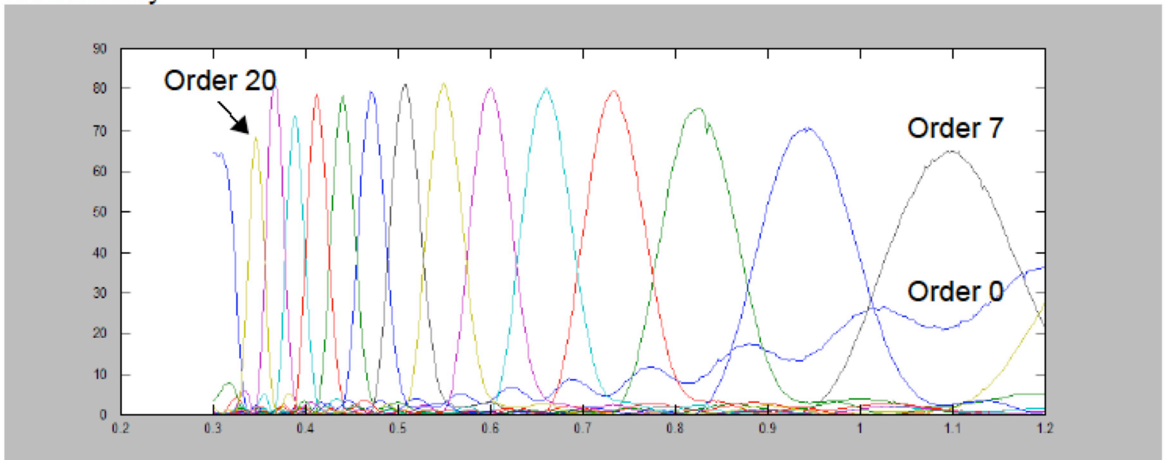
Images of the first order diffraction

CITIZN Holdings Ltd.

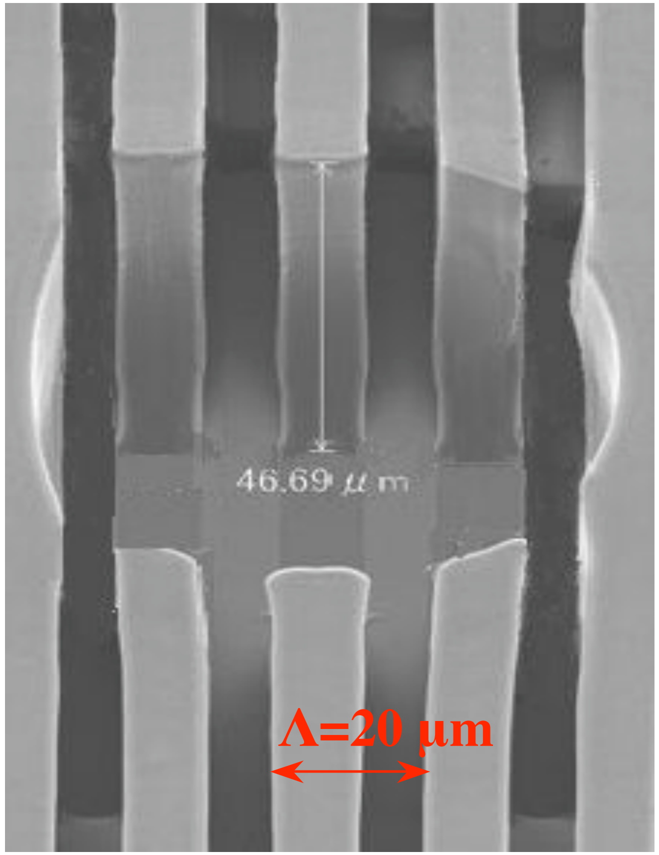
Volume Binary Grating



Configuration 1: ratio 9:1, d = 11 µm, Δn = 0.19
TE efficiency



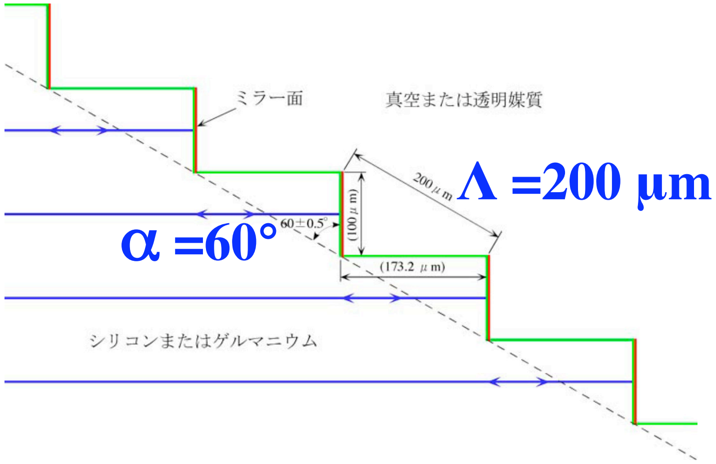
INAF Osservatorio Astronomico di Brera, Italy

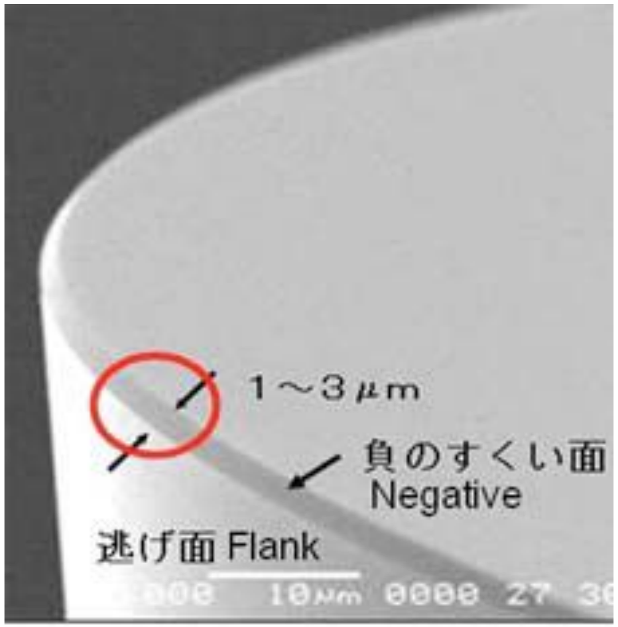


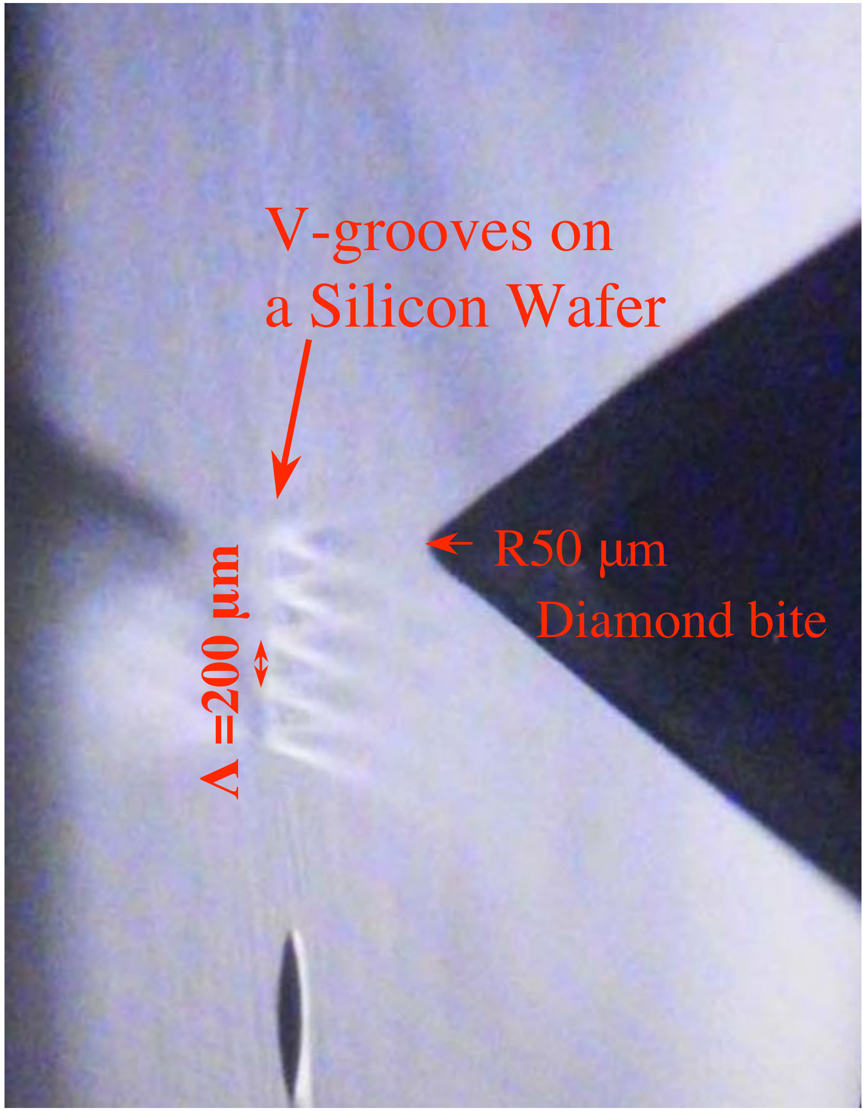
SEM image of grooves (L&S: 10µm), tilting with 30°.
Photo resist: KMPR1000.

Nano-Technology Platform of Toyota Technological Institute

Si (Ge) Immersion Grating

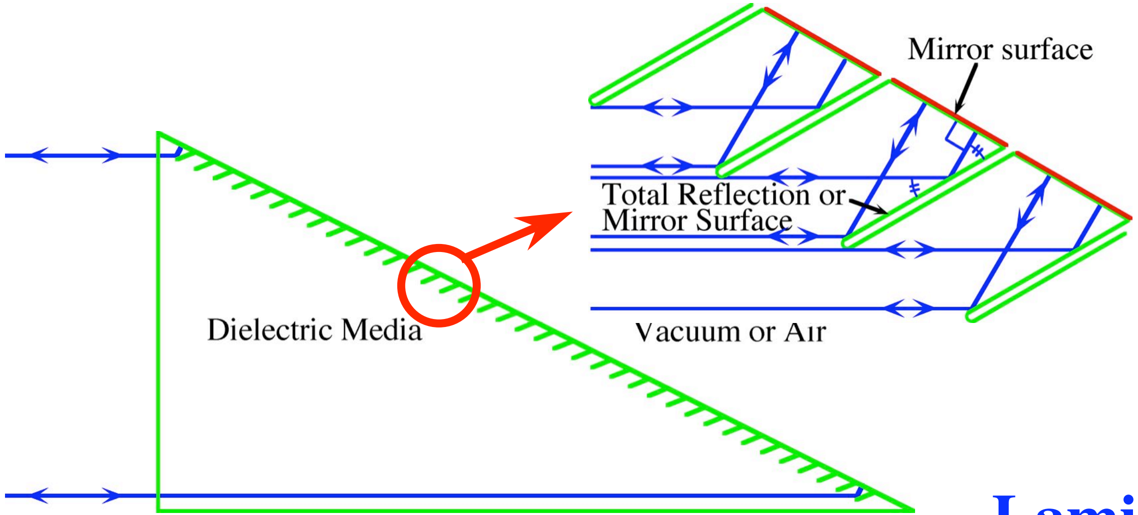


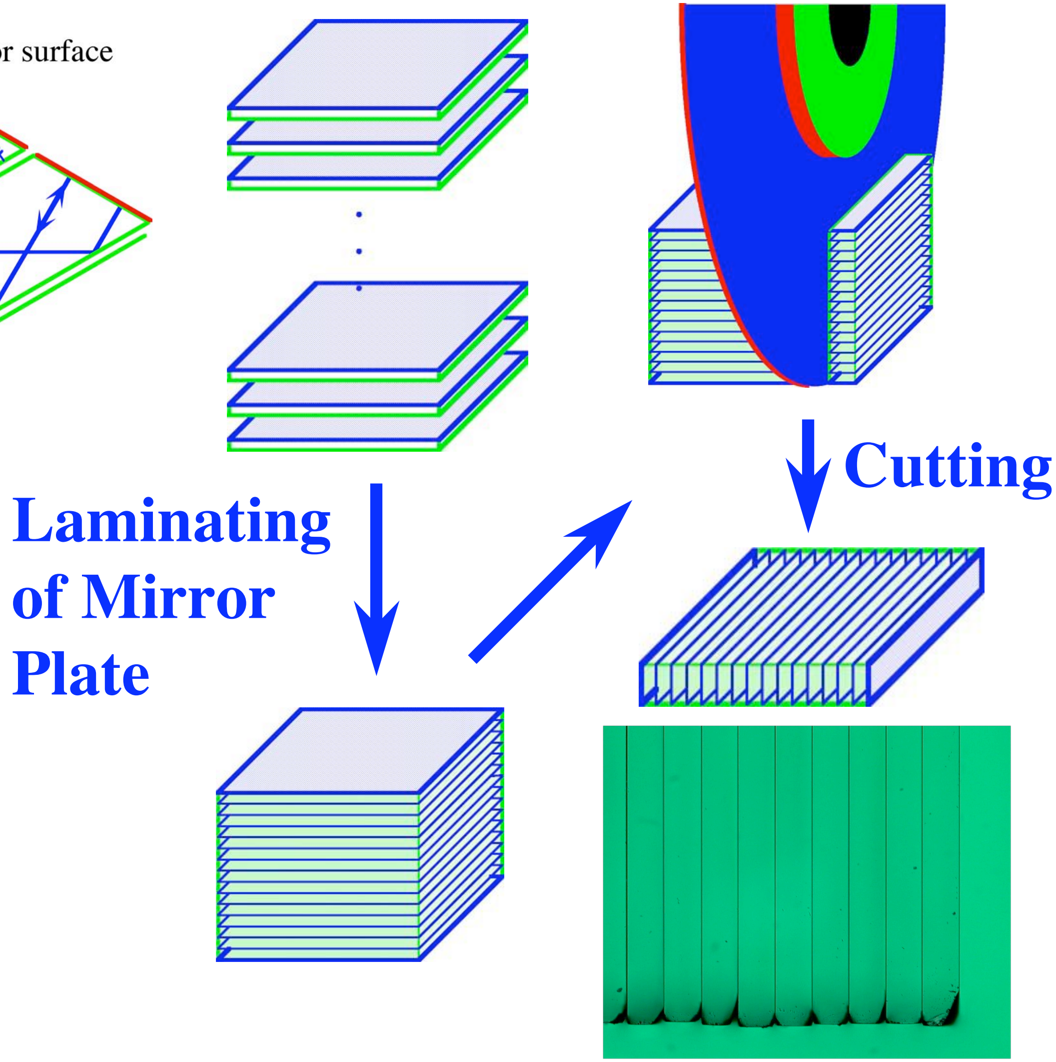


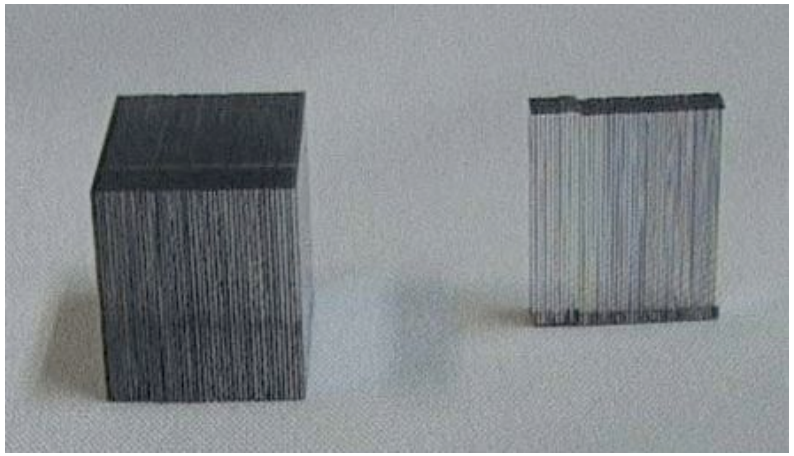


Ultrahigh Precision Optics Technology Team, Center for Advanced Photonics, RIKEN

Quasi-Bragg Immersion Grating







A: 10 x 10 x 0.2 x 40 pcs (left),
B: 1.5 x 10 x 0.2 x 40 pcs (right)
Fabricated by Kogaku-Giken Ltd.

2nd trial fabrication is performing at NTT-AT Ltd.