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Technical Notes

Technical Note 1
LASER TUNING WITH DIFFRACTION GRATINGS

Light incident on a diffraction grating is dispersed away from the grating surface at an angle which depends on the wavelength, so a grating can be used to select a narrow spectral band from a much wider band. The grating equation,

$$m\lambda = d(\sin\alpha + \sin\beta), \quad (1)$$

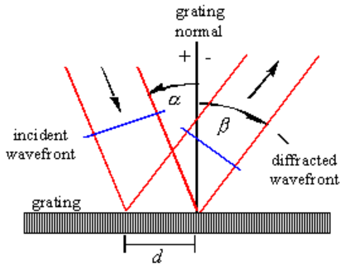
(see Figure 1) can be differentiated to give the angular spread (dispersion) of the spectrum:

$$\frac{d\beta}{d\lambda} = \frac{\sin\alpha + \sin\beta}{\lambda\cos\beta}. \quad (2)$$

When the grating is operated in the Littrow configuration (in which the light is retro-diffracted; see Figure 2), the equation for the dispersion simplifies to

$$\frac{d\beta}{d\lambda} = \frac{2\tan\beta}{\lambda}. \quad (3)$$

Figure 1 – The Grating Equation. Here *α* is the incidence angle, *β* is the diffraction angle, *m* is the (integral) diffraction order, *λ* is the wavelength of the light and *d* is the spacing between adjacent grooves.



TECHNIQUES

There are two main methods for selecting a narrow spectral band of light, *Littrow* and *Littman*. These methods are shown in Figures 2 and 3. Littman tuning offers higher angular spread and hence narrower spectral feedback; as the angle of incidence is increased toward 90°, however, the efficiency of the grating drops significantly.

Figure 2 – Laser tuning using a grating in Littrow mode as the feedback element.

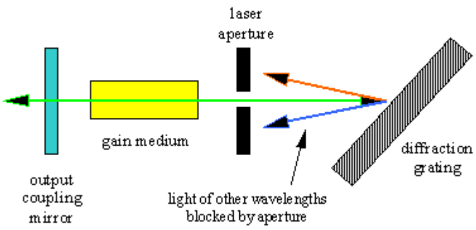
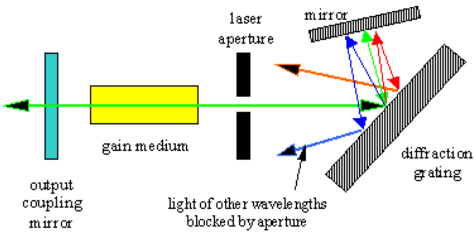


Figure 3 – Littman tuning using a grating near grazing incidence.



Figures 4 and 5 show typical efficiency curves for two popular plane holographic gratings, with groove frequencies of 1800 g/mm and 2400 g/mm. The curves are measured near Littrow.

Figure 6 gives some insight into the decrease in S-plane efficiency as the incidence angle *α* increases.

Figure 4 – Efficiency curve: 1800 g/mm. Red dashed curve: P-plane; solid black curve: S-plane.

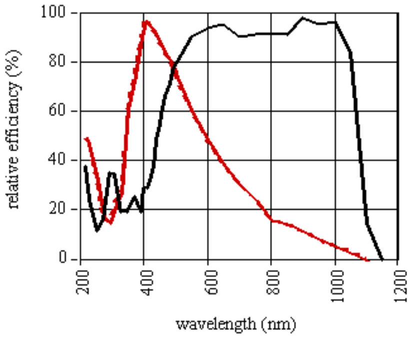


Figure 5 – Efficiency curve: 2400 g/mm. Red dashed curve: P-plane; solid black curve: S-plane.

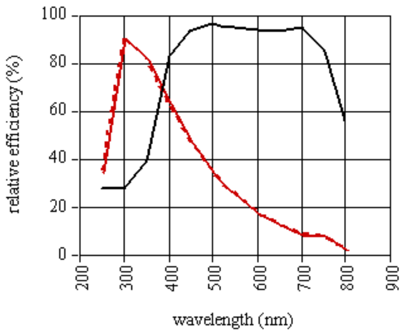
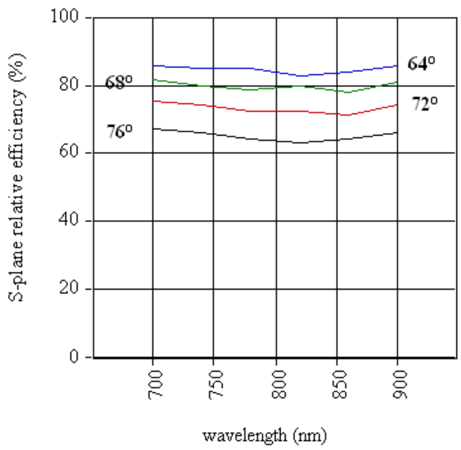


Figure 6 – Efficiency curve: 1800 g/mm, for several incidence angles *α*.



FOR FURTHER INFORMATION

For additional information, please contact us.

SOME TECHNICAL REFERENCES

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