How to Select Gratings: HOLOGRAPHIC VS. RULED GRATINGS -- WHICH TO USE

Since the introduction of the first practical Holographic grating in 1967, considerable confusion has arisen over which type of grating to use for a given application. We at GratingWorks, in recognition of this difficulty have performed various experiments with Holographic and ruled gratings to ease grating selection.

A. Stray Light and Ghosts

Using a monochromator with both holographic and ruled gratings (all 1200 G/mm), spectra were recorded of the helium-neon 6328A laser line. The stray light levels measured with the ruled grating were at least ten times as intense as that measured with Holographic gratings. Claims by the manufacturers of Holographic gratings indicate that stray light will increase for ruled gratings as groove density increases. Holographic gratings do not exhibit this increase in stray light with groove density.

A holographic grating may be better suited for applications requiring low stray light and or dense groove spacing. Ruled gratings are normally chosen when efficiency and overall throughput of the optical system are of primary concern.

B. Grating Efficiency

The efficiency of a Holographic grating in the UV-visible and near IR was compared to the efficiency of a ruled grating blazed at 500. A tungsten halogen source and a monochromator was used to illuminate the gratings. The Holographic grating exhibited more pronounced Wood's Anomolies than the ruled grating, and the Holographic grating has only about half the efficiency of the ruled grating at the blaze wavelength. However, newer processes are improving the efficiency of holographic gratings. C. Blaze Angle

The useful range of a grating can be conveniently described by the 2/3 - 3/2 rule of thumb. This says that the range of a grating has a lower limit = 2/3 blaze wavelength and an upper limit = 3/2 blaze wavelength. Thus, for a grating with a blaze of 300 nm, its useful range is 200 to 500 nm. It is not unusual to be able to operate the grating with reasonable efficiency above the 3/2 rule of thumb value. However, this is not suggested on the short wavelength side below the 2/3 rule of thumb value (the efficiency can be zero at ½ blaze wavelength.)

D. Conclusions and Recommendations

The choice of the type of grating that an experimenter should use depends upon the type of measurement to be made. For a weak source the likely choice would be a ruled grating with a blaze near the wavelength of interest. Holographic gratings would be used where a high signal to noise ratio is desired, specifically, where a source of sufficient intensity is available and the scattered light or ghosts would interfere with the measured data. Finally, since the stray light increases with groove density for a ruled grating, but not for a holographic, for higher groove

density gratings the contrasts would be even greater. Maximum groove density for ruled gratings is 3600 G/mm while 6000 G/mm grating have been produced holographically.