ONDAX

Alignment Procedure for Volume Holographic Gratings in External Cavity Lasers

Volume Holographic Gratings (VHG's) can be categorized by two different types, transmission and reflection. This document assumes that the VHG's are of reflection type, i.e. the diffracted beam is on the same side as the incident beam.

The grating structure of VHG's is within the bulk material. VHG's have similar properties to BK7. They can be handled similar to optical components such as lenses. Ondax generally manufactures VHG's with an anti-reflection coating. Use vacuum pickup tools or soft-tip tweezers to prevent damaging the coating or scratching optical surfaces.

Acetone and isopropyl alcohol can be used to clean the VHG's facets.

VHG's manufactured by Ondax have a small controlled slant angle. As a result, the angle between the diffracted beam and the surface normal is typically 0.45 degrees (See Figure 1). The slant angle avoids the specularly reflected light from the surface to co-propagate with the diffracted beam.

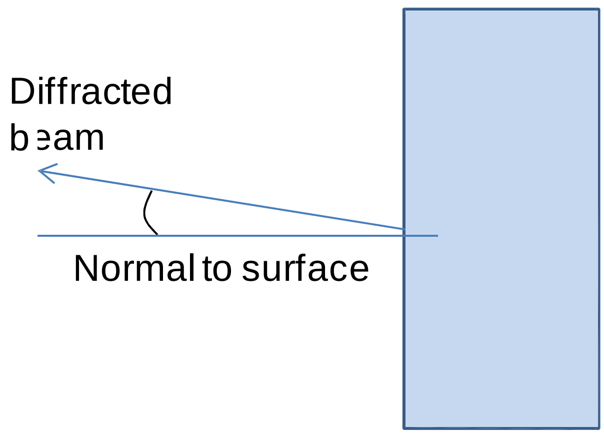

Figure 1: Angle between Surface Normal and diffracted beam

Alignment Procedure:

The basic principle in locking the wavelength of the laser diode is to orient the VHG so that the diffracted beam (filtered beam) is propagating in a direction opposite to the collimated beam. The alignment sensitivity of the VHG depends on the size of the emitter and the collimating optics. Because the emitter is smaller in the fast axis direction (emitter dimension typically 1 µm), the rotation in the fast axis is more sensitive than the slow axis (emitter size vary from 50 µm to 200 µm for high power lasers).

The alignment procedure is valid for single emitters or an array of single emitters (bars).

Figure 2 shows a side view laser diode with a fast axis collimator (FAC) to collimate the fast axis of the laser.

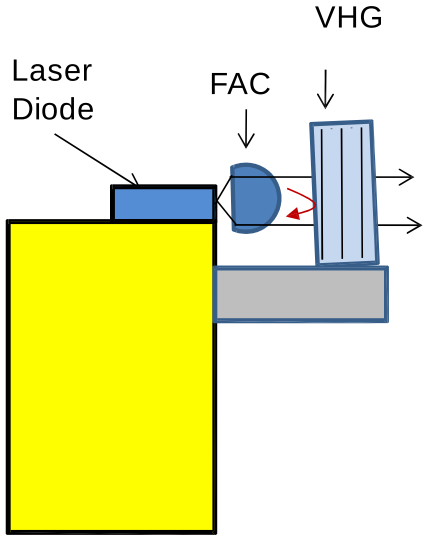

Figure 2: Side view: Laser Diode Collimated with Fast Axis Lens

The slow axis is freely diverging as figure 3 illustrates. A spherical lens is used to capture the light from all the emitters to direct it inside an integrating sphere or on the surface of a diffuser. The fiber from an Optical Spectrum Analyzer collects the light from all emitters.

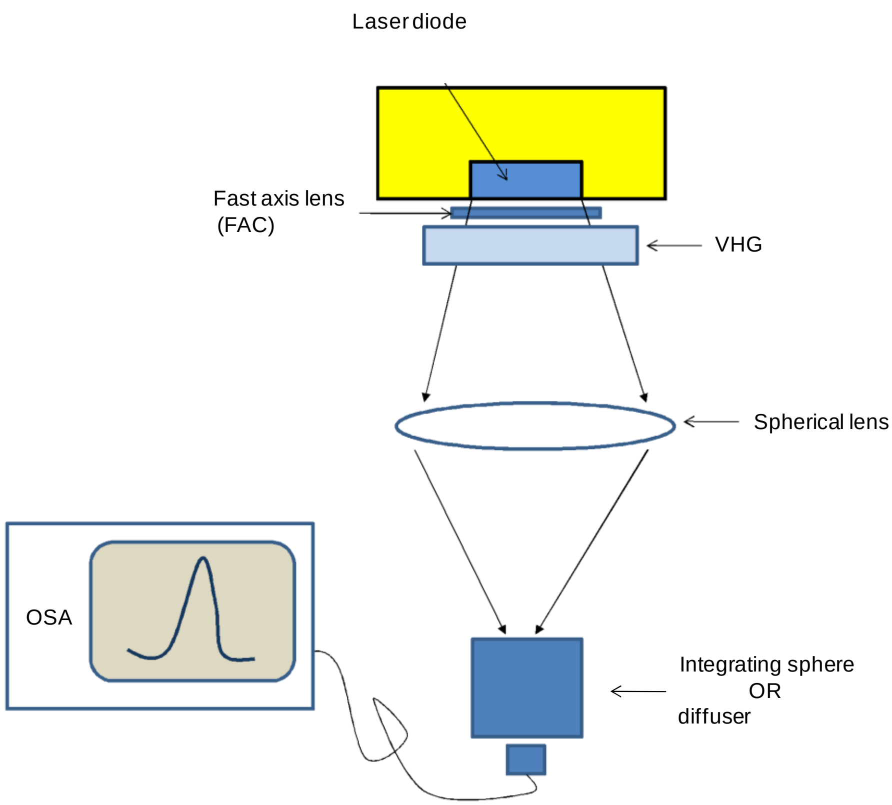

Figure 3: Top view: Laser Diode Collimated with Fast Axis Lens

- The spectrum of the laser diode should be within a few nanometers of the specified VHG wavelength.
- Mount a VHG onto a glass submount.
- Place epoxy on the surface of the VHG glass mount. This epoxy will be used to fix the VHG alignment. Do not place too much epoxy otherwise it may wet onto laser diode facet. Providing a notch on the submount will help prevent the epoxy from flowing.
- Place the VHG mounted on submount on a 6 axis stage (3 axis XYZ and 3 angles). For example use http://www.thorlabs.com/NewGroupPage9.cfm?ObjectGroup_ID=1100
- The gap between the VHG and the fast axis lens is not critical. Use a couple of mm to ensure that the VHG is not in contact with the FAC.
- Referring to figure 3, adjust the long facet of the VHG to be approximately parallel to the long side of the lens.
- Turn on the laser diode to low power (~1/10th of full power).
- Adjust the height of the VHG so that the collimated light is not clipped by the VHG.
- Observe the optical spectrum on the OSA while adjusting the angle of the VHG around the fast axis (the axis with the most angular sensitivity). A narrow peak at the wavelength of the VHG should appear once it is close to optimum alignment. At this point, light is being diffracted back into the laser cavity. Fine tuned both the slow axis and fast axis angle to optimize the locking.
- Turn the laser to full power and re-align slightly if necessary.
- Turn off the laser diode and illuminate the VHG submount with UV source to cure the epoxy.

The broad spectrum of a free running laser bar is shown in figure 4 along with the narrowband spectrum after wavelength stabilization (black curve).

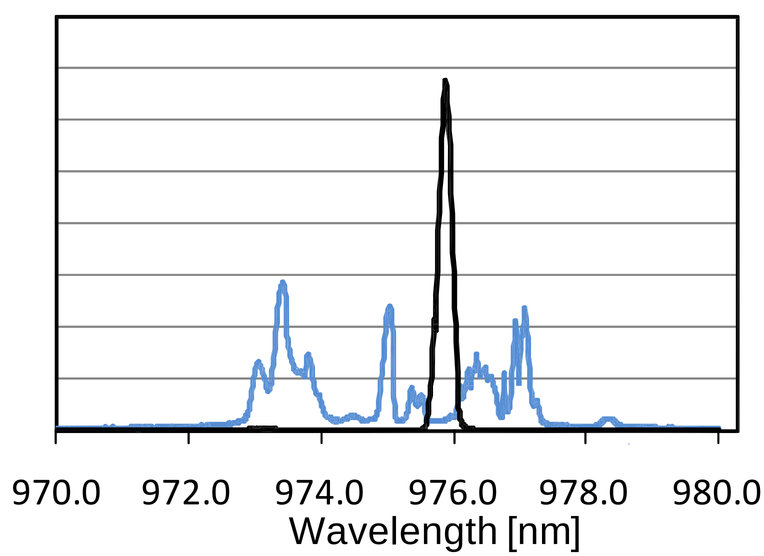

Figure 4: board spectrum of the free running laser superimposed with the narrow band spectrum after wavelength stabilization (black curve).

Once aligned properly, the stabilized wavelength is fixed by the VHG. Due to thermal expansion of the VHG material, changing the temperature of the VHG could vary the wavelength. The temperature dependence of the wavelength is typically 10pm/deg. C.