Optical alignment for wavelength locking by use of a VBRG element
1. General comments

1.1 The Volume Bragg Grating elements (VBRGs) should be handled like other optical components, e.g. lenses.

1.2 Regular cleaning procedures can be applied, including the use of ultra-sonic tubs. The use of regular cleaning solutions (e.g. acetone, alcohols, soap etc.) is permitted without restrictions.

1.3 The hardness of the bare VBRG glass is similar to BK7. However, most VBRG elements are anti-reflection coated and these coatings can be damaged more easily than the bare glass. Use of the soft-tip tweezers or vacuum-picks is strongly advised to avoid chipping and/or scratching of the VBRG elements.

1.4 No special storage conditions are necessary.

1.5 When performing the wavelength locking tests, the cylindrical lens can be either adjusted independently of the VBRG (Method 1) or attached directly to the VBRG surface (Method 2).

2. Installation

2.1 Clean the VBRG element and the lens.

2.2 If the experiments will be performed with the lens adjusted independently of the VBRG element (Method 1), proceed to step 2.3.

2.2.1 Attach the lens to the VBRG, if desired. To do so locate the coated sides of the VBRG.

2.2.2 Place the lens directly on the surface of one of the coated VBRG sides and align the axis of the lens parallel to the long side of the VBRG.

2.2.3 Fix the lens at its ends using adhesive.

2.3 Mount the lens and the VBRG in their holder(s).

2.4 Prepare the laser diode bar. (Make sure the laser diode is connected to the appropriate current source and is temperature controlled, if necessary.)

2.5 Position an integrating sphere so that it captures all the light from the laser diode bar.

2.6 Connect the fiber port of the integrating sphere to a spectrometer or an optical spectrum analyzer.

Fig. 1. LD bar wavelength locking using a single VBG element: general arrangement.

Fig. 2. Collimation schematic on the fast and the slow axis.
3. Alignment

In general, wavelength locking is achieved when the fast axis of a laser diode is near collimation and the VBRG element is positioned behind the lens to reflect some of the laser diode light back into the laser cavity (see Figures 1 and 2). (Note that “diffraction limited” collimation of the fast axis is not necessary.) The required degrees of freedom for the alignment Methods 1 and 2 are shown in Figure 3.

3.1 Bring the lens into close proximity to the laser diode bar and achieve collimation for all the emitters in the bar. The light output of the laser diode bar should appear as a sharp straight line at this point, without significant curvature or blurred edges.

3.2 Observe the output spectrum of the laser diode bar and begin adjustments of the VBRG element. The most sensitive adjustments are the VBRG rotation around the long axis of the VBRG element in Method 1 or its vertical translation in Method 2.

3.3 When the VBRG position is near its optimum, an additional narrow peak will appear on the emission spectrum of the laser diode bar at the VBRG peak wavelength. Once this peak is observed, utilize all the alignment degrees of freedom to maximize the optical power in that peak.

Fig. 3. Alignment adjustments to achieve locking.