Superluminescent diodes with output power over 1 W and with diffraction-limited beam quality

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High power and good beam quality are desired for broadband semiconductor light sources in many applications. We designed a new type of broad area super luminescence light source that is capable of emitting 1.4 watt output with diffraction limited far field divergence. Without any AR coating, the emitted spectrum has 20nm FWHM and free of the modulation caused by Fabry Perot modes.

The designed waveguide pattern is shown in Fig. 1. The waveguide is tilted at an angle from the facet normal. The tilt angle is 6° . In addition, two triangular parts are cut away from the waveguide, as shown in Fig. 1. The emitting aperture of this device is 100 μm in width, and the total device length is 1960 μm . The active layer is designed for 1310nm wavelength grown on the InP substrate.

Fig. 2 is the L-I curve of this device. The L-I curve of this diode has a threshold-like behavior at 1Amp. Below the threshold, only 3mW output power is observed. Above this threshold, the output power increase linearly with current. The slope efficiency is 0.15W/A. The measured output power can achieve 1.4W per facet when the current is 12Amp. However, spectrum observation shows that this device has no oscillation modes. With 6Amp injection current, the measured spectrum has 20nm FWHM, as shown in Fig. 3. The spectrum profile is smooth and no F.P. mode is observed. Thus, this device is not a laser diode but a super luminescence diode.

The far field pattern of this device is measured. The light emitted from the device is at 32° away from the direction of facet normal at the same side as the tilted direction of the waveguide. The FWHM of the far field is 2° . The measured near field pattern has 43 μm FWHM at the same current of 6 Amp. The farfield divergence is equal to the diffraction limit angle of the near field distribution.

Fig. 1 Waveguide Design

Figure 2 L-I curve

Figure 3 Emission Spectrum at 6 Amp with 20nm FWHM

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