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1050-nm high power diode array module

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High power diode array module has been fabricated. The epitaxial structure is an InGaAs/GaAsP strain compensated single quantum well. The laser bars are made with a filling factor of 84.6%. The module's quasi-continuous wave (100 μs, 1000 Hz) peak power can reach to 88.6 W at a current of 100 A. The central wavelength is 1050 nm and the full width at half maximum is 4.2 nm.

Optimized structure and conglutination between optical film and cavity facet were designed. The front and the back cavity facet coatings are sub/1.18Al2O3/air and sub/Al2O3 0.45TiO2 1.55SiO2 (TiO2 SiO2)3 TiO22/air, respectively. The first layer Al2O3 can improve the conglutination and the use of TiO2 can reduce the amount of growing layer. The layer of the back cavity facet is not regular 1/4 wavelength, which can reduce the strength of electrical field of the TiO2 layer and therefore reduce the absorption of the layer stack.

Figure 2 shows the experimental and theoretical curves of AR-coating of the front cavity facet (measurement slices are GaAs substrate). The facet reflectivity reached 5.12% through theoretical calculation (InGaAs substrate). Figure 3 shows experimental and theoretical curves of HR-coating of the back cavity facet (measurement slices are K9 glass). The facet reflectivity reached 96.7% through theoretical calculation (InGaAs substrate). The theoretical and experimental results fit well, and the reflectivity of optical coating fits the design result.

We adopted laser bars as laser module. Every bar was composed of several tens or several hundreds of emitting cells. The structure of laser bar should be optimized because the filling factor and isolation will affect operation performance. The laser bar with a stripe width of 110 μm (period of 130 μm) and a filling factor of 84.6% was fabricated. The isolation region between emitting cells formed by photolithography and wet etching was used as confining optical oscillation. The wafer was cut into bar stripe with cavity length of 1200 μm after p- and n-side was evaporated TiPdAu and AuGeNi respectively. The front and back facets are coated with AR...
and HR coatings respectively. The p-side of bar stripe was soldered to heat-sink through Indium solder. The n-side and the upper electrode were connected with Cu foil. The p-side and n-side electrodes were isolated through isolation film. The laser module was cooled by refrigerating system.

Figure 4 is the measurement results about output power, electrical voltage and electrical current. The measurement conditions are follows: pulse width of 100 µs, frequency of 1000 Hz. The maximal output electrical current of power supply is 100 A. From Fig. 4, it can be seen that the threshold current of laser bar is 10 A. The peak output power is 88.6 W and slope efficiency is 0.98 W/A under electrical current of 100 A and electrical voltage of 2.97 V. Based on these operation condition, the laser bar still keeps good linearity. Figure 5 is the electro-optical conversion efficiency of laser module. The conversion efficiency is 36% when electrical current is 50 A. The front section of the Fig. 5 is not slippery under condition of small electrical current, which results from few measurement points due to larger error of power meter when average power of laser module is low. Figure 6 is the optical spectrum of laser module with 200 µm fiber detector and integraph under condition of 100 A. The central wavelength is 1050 nm and full-width at half-maximum (FWHM) is 4.2 nm.

The module was tested under direct current and 20 °C. The threshold current is 10 A and the central wavelength is 1050.0 nm with FWHM of 4.2 nm. The module’s QCW output power reaches to 88.6 W at a current of 100 A.

In conclusion, a 1050-nm wavelength region laser module is designed, fabricated and assembled, and QCW output power of 88.6 W is obtained.

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References