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High Coupled Power 0.98 μm Narrow Beam Lasers

A. Shima, T.Kamizato, A. Takemoto, S. Karakida, Y. Nagai, Y. Yoshida and E.Omura

Optoelectronic & Microwave Devices Laboratory, Mitsubishi Electric Corp.
4-1, Mizuhara, Itami City, 664 Japan

Abstract

Record high kink-free coupled power of 121mW has been realized by narrowing the beam divergence in 0.98 μm lasers.

Introduction

It is well recognized that 0.98μm high power lasers are promising pump-sources for Er-doped fiber amplifiers because of their high pump efficiency and low noise potential. For the pump sources the diodes are strongly required to have a high coupled power into a single mode fiber. To obtain kink-free high power performances in the fibers, the oscillating mode should be stable and the beam divergence should be as narrow as possible without any expense such as the rise of the threshold currents and the degradation of the efficiency. Recently, a coupled power of 100 mW has been reported in 0.98μm InGaAs lasers[1].

In this paper, record high kink-free coupled power of 121 mW is demonstrated by optimizing the waveguide structure with taking the outgoing transverse mode to the high-refractive index materials of a GaAs substrate and a contact layer into consideration.

Device Structure

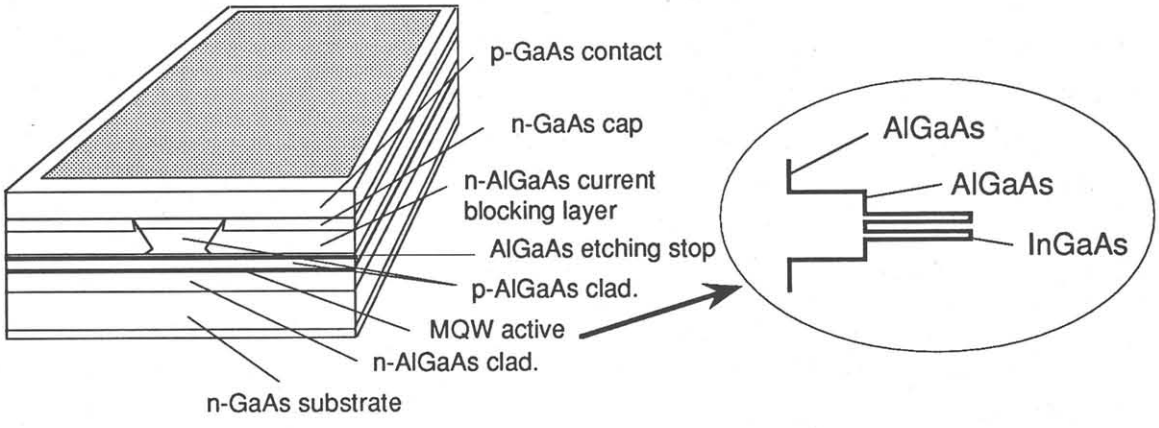

Fig.1 Schematic drawing of 0.98μm high power laser

A device structure is schematically shown in Fig. 1. To reduce the beam width perpendicular to the junction plane, thicknesses of the $In_{0.16}Ga_{0.84}As$ well, $Al_{0.2}Ga_{0.8}As$ barrier and $Al_{0.2}Ga_{0.8}As$ guide layers are designed to be 8nm, 5nm and 24 nm, respectively. The $Al_{0.48}Ga_{0.52}As$ cladding layers are set to be thick enough to

attenuate the evanescent mode to the high-refractive GaAs layers. To reproducibly stabilize the transverse mode, the AlGaAs etching stop layer has been applied. It should be noted that an n-AlGaAs current blocking layer is employed in our device[2]. The AlGaAs current blocking layer has the advantage that it provides the wide range of refractive index by changing the Al mole fraction, resulting in the increase of freedom of the device designing. To cutoff the higher order transverse mode, the ridge "waist" width is controlled to be 0.5 to 1.0 μm. The cavity length is 600μm. The mirror facets are HR(90%) and AR(4%) coated. The chips are mounted junction down.

Characteristics

Threshold current is as low as 17mA and a slope efficiency is as high as 0.98W/A.

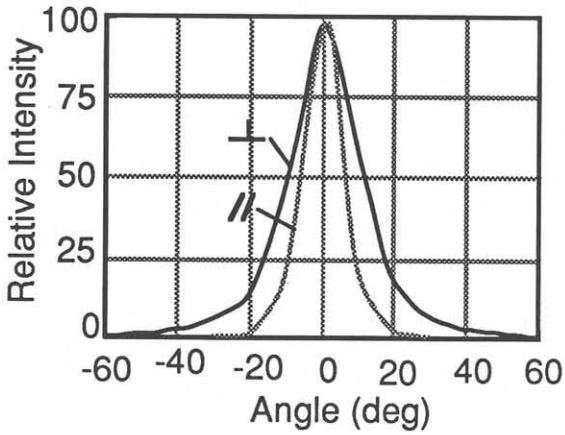

Fig.2 Far-field patterns at 100mW.

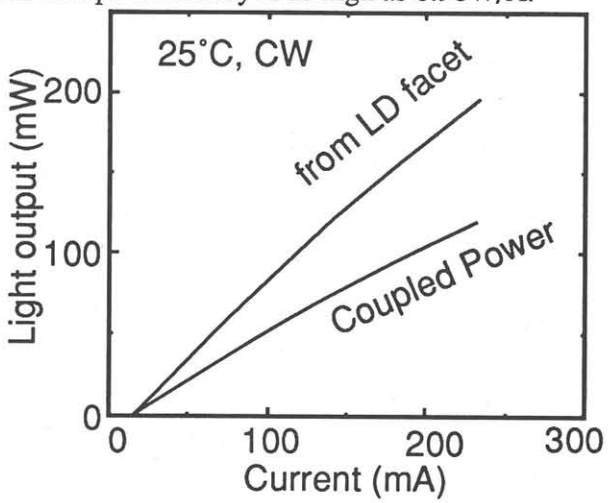

Fig.3 Power-current characteristics

The far-field patters are depicted in Fig. 2. The FWHM's of parallel and perpendicular to the epi-layers are 11.5° and 21.1°, respectively. The aspect ratio is as small as 1.8 which will make the coupling efficiency to a fiber high. Figure 3 exhibits the light output from the laser facet and the coupled power. The coupling scheme is one-lensed optics. As can be seen in the figure, the kink-free light output over 200mW has been obtained and the coupled power at the laser facet power of 200mW is 121 mW. The estimated coupling efficiency is as high as 60% owing to the narrow beam divergence.

Summary

Record high coupled power into a fiber has been successfully realized by properly designing the active waveguide.

References

[1]H. Chida et al., Proc. of the 1994 IEICE spring conference, C-255.

[2]A.Shima et al., Extended Abstracts (The 54th Autumn Meeting, 1993) 29p-K14.