

## Wide Temperature Range Operation of 1.55- $\mu\text{m}$ , 10-Gbit/s, EA-DFB Laser for 80-km SMF Transmission

We have developed a 1.55- $\mu\text{m}$  uncooled electroabsorption modulator integrated distributed-feedback (EA-DFB) laser with an InGaAlAs multiple quantum-well active/absorption stripe. We demonstrated an 80-km single-mode fiber (SMF) transmission at 10 Gbit/s over an extremely wide temperature range of 125 $^{\circ}\text{C}$  (-25 to 100 $^{\circ}\text{C}$ ).

EA-DFB lasers have been widely used as 10-Gbit/s optical transmitters, because of their inherent advantages of high speed, low chirp, compactness, and ease of operation. Most of these devices are commonly used as light sources for 10-Gbit/s, 40- and 80-km applications.

In recent years, the widespread adoption of 10-Gbit/s technology for telecom and datacom applications has been mainly driven by the need to reduce both power consumption and fabrication costs. EA-DFB laser operation without a thermoelectric cooler (uncooled operation) is effective way to reduce power consumption, since the thermoelectric cooler accounts for most of the power consumed by a light source module.

To realize the uncooled operation of an EA-DFB laser, both the laser and EA modulator were fabricated from InGaAlAs material, because this material has temperature-tolerant characteristics. We designed the

laser and the EA modulator independently, and directly butt-joined these two components. Figure 1 (a) is a photograph of the fabricated 1.55- $\mu\text{m}$  InGaAlAs EA-DFB laser, and Fig. 1 (b) is a scanning electron microscope (SEM) image of the butt-joined section.

We used this device to perform an SMF transmission experiment. Figure 2 (a) shows the filtered eye diagrams obtained when only the DC bias voltage applied to the EAM was adjusted at all temperatures. Clear eye openings were obtained at all operating temperatures. Figure 2 (b) shows the temperature dependence of the back-to-back (BTB) dynamic extinction ratio (DER) and the power penalty (PP) after an 80-km SMF transmission. A DER of over 9 dB and a PP of less than 2 dB were obtained at all operating temperatures.

These results clearly show that this EA-DFB laser has the potential for uncooled operation.

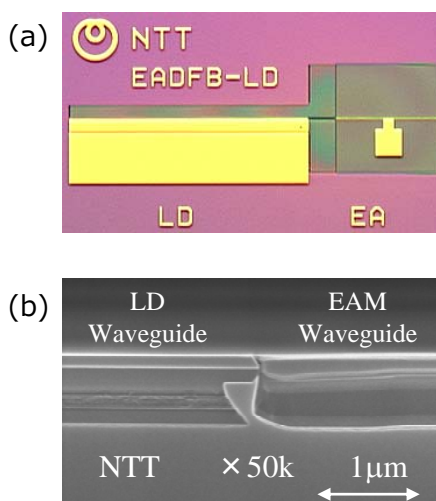


Fig.1 (a) Photograph of fabricated InGaAlAs EA-DFB laser.  
(b) SEM image of butt-joined section.

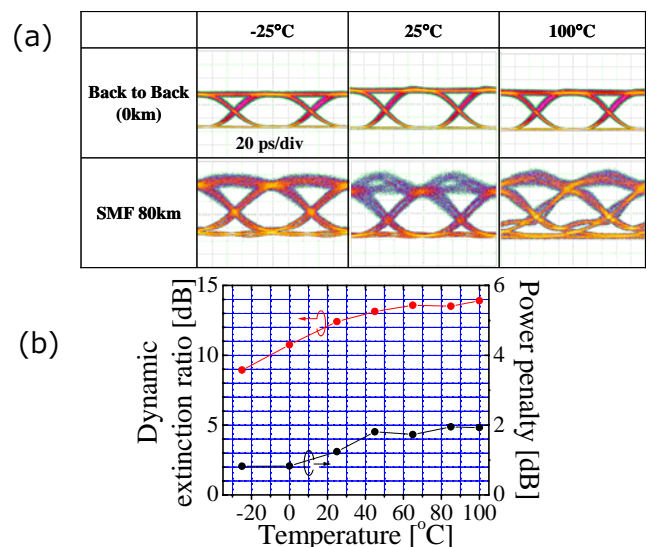


Fig.2 (a) Eye diagrams for a BTB and after 80-km SMF transmissions at -25 $^{\circ}\text{C}$ , 25 $^{\circ}\text{C}$  and 100 $^{\circ}\text{C}$ .  
(b) Temperature dependence of DER and PP.