초청강연1

10Gbps Operation of 1.5um Single-mode QD Laser

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Quantum dot laser diodes (QD LDs) are expected to have superior device properties, compared to their low dimensional (1D or 2D) quantum-confined counterparts, in that they show extremely low threshold current (I_{th}), high characteristic temperature (T_0), large bandwidth, and a reduced chirp value. With the advent of self-assembled semiconductor QDs grown in the Stranski-Krastanov mode, applications of QDs in semiconductor laser diode structures have been possible in the 1.3 um window in the case of In(Ga)As QDs grown on a GaAs substrate. However, at an emission wavelength of 1.5 um, a more efficient wavelength for long-haul fiber optic communications, In(Ga)As/InP quantum structures such as quantum dashes and QDs embedded in InAlGaAs barriers, and In(Ga)As QDs in an InGaAsP matrix have been widely studied due to the wavelength limitations of GaAs-based material systems. Several reports on LD applications of InP-based QDs have appeared. Recently, we reported the single-mode operation of an InAs distributed feedback (DFB) QD LD emitting at 1.55 um.

In this experiment 7 stacked QD layers were grown on an InP substrate with the grating structure and processed to be ridge waveguide type laser diode. Unlike our former result, we grew the epitaxy structure using a metal-organic chemical vapor deposition (MOCVD) to make commercially viable device. Devices with 0.4 mm cavity length showed threshold current of 10 mA, one-facet external quantum efficiency above 0.15 W/A and peak wavelength of 1.55 μm. Measured 3-dB bandwidth was as wide as 7 GHz. From the parasitic extraction experiment bandwidth was considered to be limited by electrical parasitics like bonding pad capacitance and series resistance not optical bandwidth in this frequency range. Device also showed clear eye diagram at 10 Gbps modulation.