Investigation of device length dependence of 1.55-μm-band QD-RSOA in threshold current of SiPh-based heterogeneous tunable laser

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To realize a low-threshold, high-power, wavelength-tunable, two-wavelength simultaneous oscillation transmitter for radio-over-fiber (RoF), we evaluated the relationship between the device length of quantum-dot reflective semiconductor optical amplifier (QD-RSOA) and the threshold current of the heterogeneous laser using a Si-photonics (SiPh) chip with a common double-ring structure and the QD-RSOA. This is noteworthy because there are few reports on the device length dependence of QD-RSOAs in the 1.55-μm-band.

The fabricated QD-RSOAs consist of n- and p-InAlAs cladding layers, 15 pairs of InGaAlAs embedded layers and InAs QD layers, and a p+-InGaAs contact layer grown on an InP(311)B substrate. The QDs are 3 ML in height with a 3.5μm ridge structure width, and one facet has an anti-reflection (AR) film. The SiPh-based chip has a spot size converter (SSC) and a series double-ring resonator which resonant wavelength is tunable by the microheaters. The QD-RSOAs with device lengths of 2000μm, 3000μm, and 3500μm were used and their end faces were coupled to the SiPh chip.

The I-L curve of this heterogeneous laser, shown in Fig,1(a), indicates threshold currents of about 60.7mA, 59.7mA, and 123mA, respectively. This suggests that shorter QD-RSOA device lengths reduce the threshold current. Fig,1(b) shows that adjusting the oscillation wavelength with the microheater changes the output spectrum in each QD-RSOA, achieving a wavelength tunable range of about 40nm.

In this study, we experimentally investigated how the threshold current varies with the device length in QD-RSOA and demonstrated 40nm wavelength tunability as a heterogeneous QD tunable laser.