Direct Modulation Bandwidth Enhancement Method based on Active-Multimode Interferometer Laser Diode Utilizing Multiple Photon Photon Resonance

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I. Introduction:

Photon-Photon Resonance (PPR) phenomenon as bandwidth enhancement method [1, 2] on active-MMI LD was firstly reported in 2014 [3]. However, for extremely high speed laser targeting over 100 Gbps, single PPR is not enough because of the serious damping mechanism [4]. To solve the problem and achieve 100 Gbps level direct modulation LD, we propose and demonstrate multi-cavity active-MMI LD that performs multiple PPR peaks.

II. Concepts and Design:

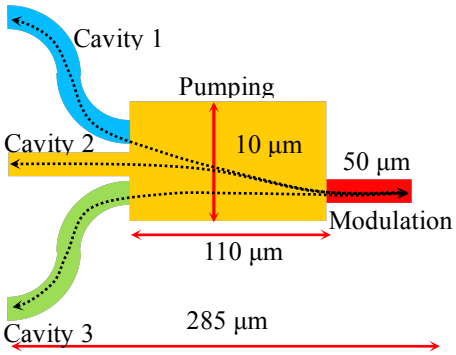

Fig. 1: Schematic view of active-MMI LD

Figure 1 shows the device structure performing multiple PPRs. To obtain multiple PPRs, several longitudinal resonance cavities are necessary. Each cavity length corresponds to a free space range (FSR) in spectrum. Overlap between different FSRs generates different wavelength differences. Preferred PPR frequency is chosen by delicate wavelength mismatch arrangement. The designed wavelength mismatch are 0.3 nm and 0.75 nm, which correspond to PPR frequency at 35 GHz and 85 GHz.

III. Experimental results and discussions:

The emission spectrum at central wavelength as well as full range of the device is shown in Fig. 2. Side mode suppression ration (SMSR) up to 25 dB was confirmed. Near the central emission peak, multiple adjacent peaks are observed. The wavelength differences between main lasing peak and sub-peaks are0.070 nm, 0.095 nm, 0.105 nm, 0.185 nm, 0.200, and 0.320 nm. Such differences clearly indicate the existence of multiple PPRs. Measured small signal frequency response (FR) is shown in Fig. 3. As shown

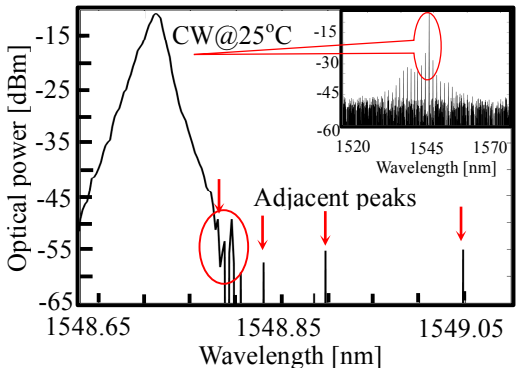

Fig. 2: Emission wavelength

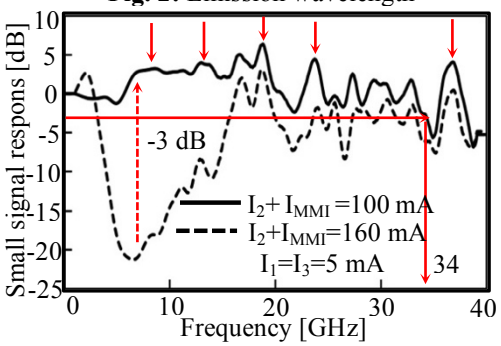

Fig. 3: Measured small signal response

in Fig. 3, at least 6 PPR peaks at 8 GHz, 10 GHz, 13 GHz, 19 GHz, 23 GHz and 36 GHz were confirmed. Such frequencies correspond to wavelength differences in Fig.2. Furthermore, by increasing pumping current, damping is compensated because of MMI effect in pumping area. 3 dB modulation bandwidth is enhanced from 5 GHz (dot line) to at least 34 GHz (solid line) by introducing multiple PPRs. Such FR result clearly proves the feasibility of extending modulation bandwidth by utilizing multiple PPRs while suppressing the damping between resonance peaks. Consequently, extremely high speed modulation over 100 Gbps is possible by introducing multiple PPRs.

IV. Conclusion:

Multiple PPRs that extend modulation bandwidth on active-MMI LD has been confirmed. 34 GHz 3 dB direct modulation bandwidth was obtained.

References:

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[4] M. Dumitrescu et al., OFC/NFOCE., JW2A.33 (2013).