Optical Random Access Memory based on Active-MMI BLDs

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Current internet routers consume huge amount of electrical power due to OE (optical to electrical) and EO (electrical to optical) signal exchanges. This leads to the necessity to develop all-optical routers that could result in energy conservation. Optical random access memory (RAM) is a key device for realizing such that all-optical routers especially for the buffering function. We have proposed and demonstrated wide hysteresis window bi-stable laser diodes (BLDs) based on active multimode interferometer (MMI) utilizing different lateral modes leads to wide hysteresis, which allows common single-current driving for the integrated devices [1]~[4]. Figure 1 shows the schematics of active-MMI BLDs. In this design, bi-stability characteristics depend mainly on the cross-gain saturation between fundamental and first-order modes [1]. This schema offers superior controllability in the portion of cross-gain saturation region, which leads to wide hysteresis window that allows common single-current driving for the integrated devices. By using this principle, we have realized low hysteresis threshold current (39mA), with maintaining sufficient hysteresis window (7mA, 18% of the hysteresis threshold) in the cavity length of only 305μm (see Fig. 2) [2], and demonstrated relatively low common operation current for 4-bit memory elements in a single chip (see Fig. 4) [3]. Moreover, we also obtained extremely wide hysteresis window extremely of 94mA utilizing MMI region partly as saturable absorber (SA) (see Fig. 3) [4].

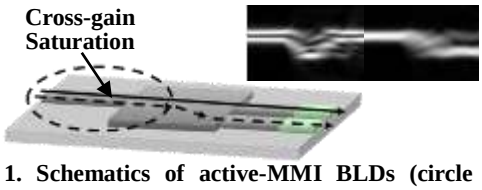


Fig. 1. Schematics of active-MMI BLDs (circle indicates cross-gain saturation region).

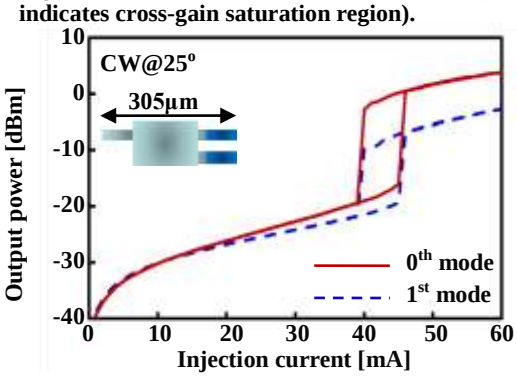


Fig. 2. Hysteresis characteristics of fabricated devices.

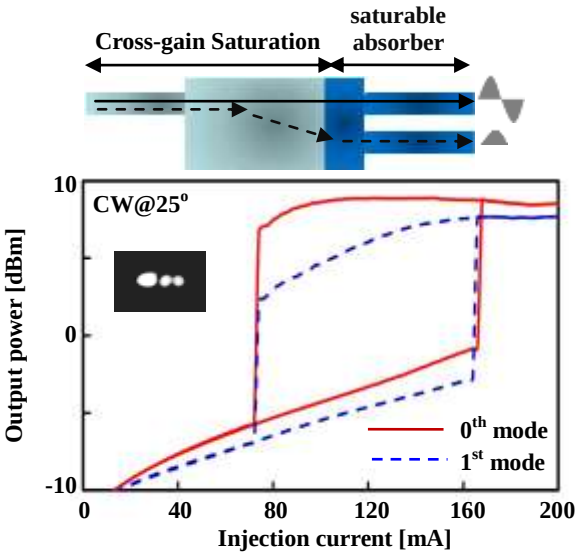
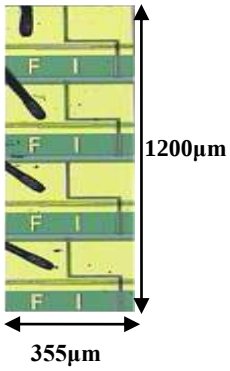
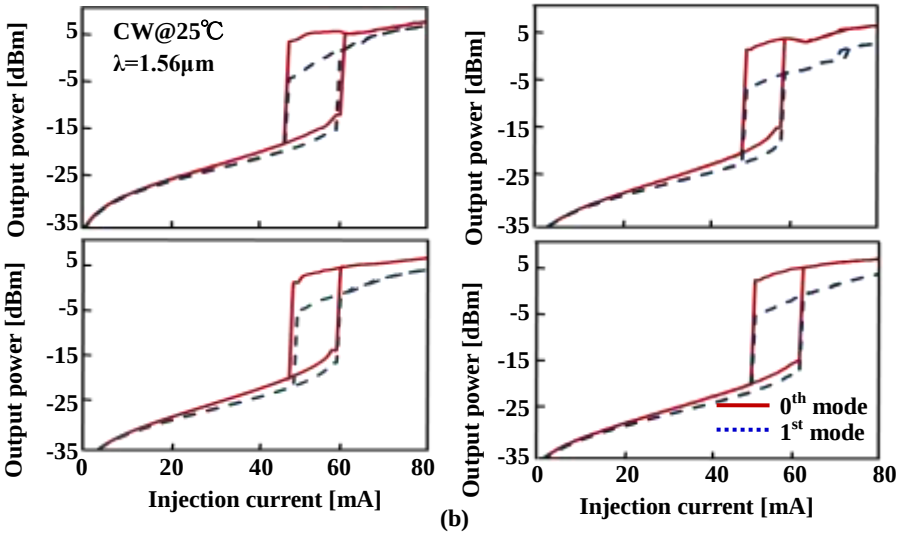


Fig. 3. Hysteresis characteristics utilizing MMI region partly as SA.



(a)



(b)

Fig. 4. (a) Microscopic top photograph of integrated 4-bit optical memory elements and (b) the hysteresis characteristics for the 4-bit optical memory elements.

References

[1] H. Jiang et al, Enginee. Science Reports, Kyushu University, 31, 1-6 (2009). [2] H. Jiang et al, J. Sel. Top. Quantum Electron. 17, 1258-1263, (2011). [3] H. A. Bastawrous et al, Proc. ECOC2008, P.2.15 (2008). [4] H. A. Bastawrous et al, in Techn. Dig. OFC, JWA34 (2010).