# Continuous Emission-Point Shift in Vertical-Cavity Surface-Emitting Laser Controlled by Optical Feedback

Shogo Ura*, Daisuke Nii, Chikara Ito, Shinichiro Shoda, Kenzo Nishio, Yasuhiro Awatsuji, and Kenji Kintaka[1]

*Department of Electronics, Graduate School of Science and Technology, Kyoto Institute of Technology, Matsugasaki, Sakyo-ku, Kyoto 606-8585, Japan*
[1]*Photonics Research Institute, National Institute of Advanced Industrial Science and Technology, 1-1-1 Umezono, Tsukuba, Ibaraki 305-8568, Japan*

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Emission intensity patterns and spectra of a two-transverse-mode vertical-cavity surface-emitting laser (VCSEL) were observed and measured while the position and polarization of an optical feedback light were controlled. Lasing behavior was discussed in relation to linear polarization modes. The observed emission point shift with unchanged wavelengths was explained by the superposition of two newly appeared modes.


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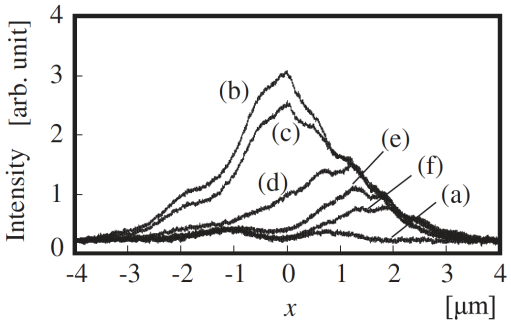


Fig. 3. Intensity profiles of *x*-polarization emissions on the *x*-axis without optical feedback (a), with feedback at the VCSEL center (b), and with feedback shifted along the *x*-axis by 0.5 (c), 1.0 (d), 1.5 (e), and 2.0 μm (f).

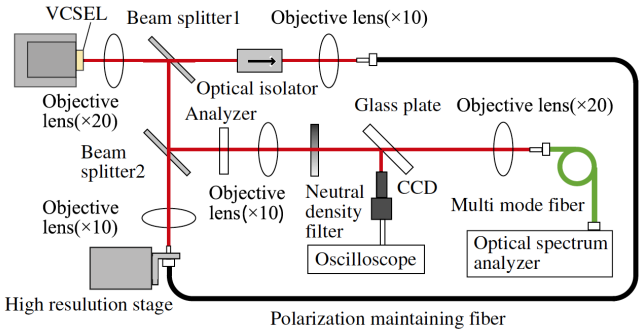


Fig. 1. Experimental setup. Output wave from the VCSEL was coupled to polarization maintaining fiber (PMF). Output wave from the other end of the PMF was focused back to the VCSEL while the position and polarization of feedback light was controlled by the position and rotation of the PMF output end.

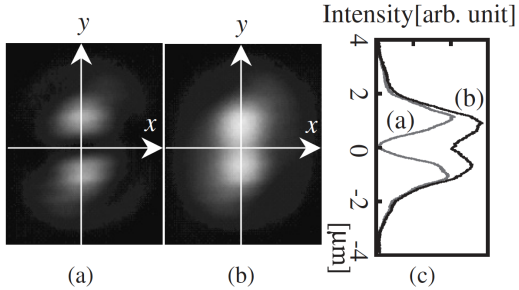


Fig. 2. Emission intensity patterns of *x*-polarization without optical feedback (a) and with optical feedback (b). Their intensity profiles on the *y*-axis are shown in (c).

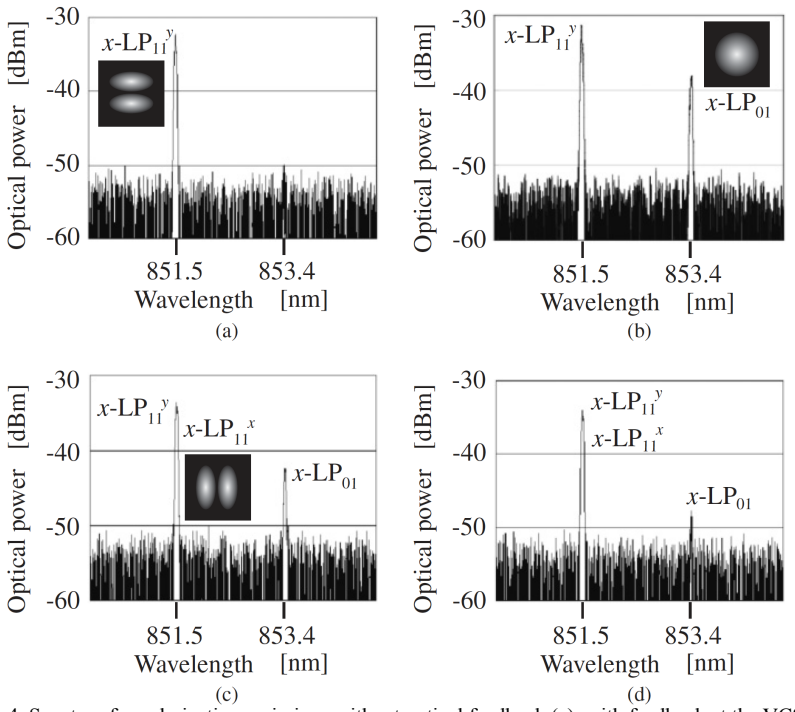


Fig. 4. Spectra of *x*-polarization emissions without optical feedback (a), with feedback at the VCSEL center (b), and with feedback shifted along the *x*-axis by 1.0 (c) and 2.0 mm (d). Emission at 851.5nm in (a) corresponds to *x*-LP11$^{y}$ mode. New modes at 853.4 and 851.5 nm under optical feedback must be *x*-LP01 and *x*-LP11$^{x}$, respectively, as discussed in the text.