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In-line rotation sensor based on VCSEL behavior under polarization-rotating optical feedback

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Abstract: Lasing behavior of a single-transverse-mode vertical-cavity surface-emitting laser (VCSEL) was observed while the polarization direction of an optical feedback was rotated. Optical powers of two polarization modes of a VCSEL showed sinusoidal dependences on the polarization-rotation angle. The power variation was seen when an optical feedback ratio was larger than –20 dB, though the variation depth dropped suddenly as the feedback ratio became smaller than –25 dB. An in-line type rotation sensor utilizing this behavior is proposed. The sensor system was constructed and the detection principle was demonstrated.

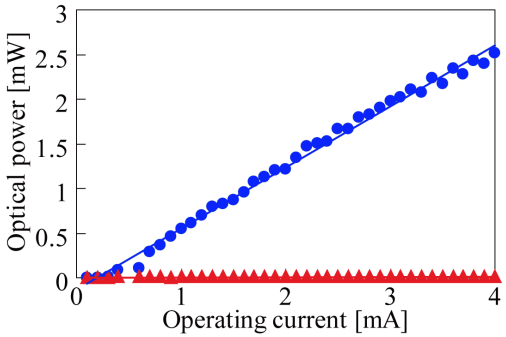

Fig. 1. Measured dependences of the oscillation powers of *x*-polarization (circles) and *y*-polarization (triangles) modes of a VCSEL upon an operating current without an optical feedback.

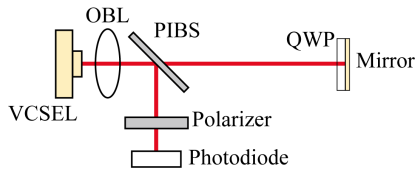

Fig. 2. Experimental setup for measuring oscillation powers of the *x*- and *y*-polarization modes under optical feedback with polarization rotation.

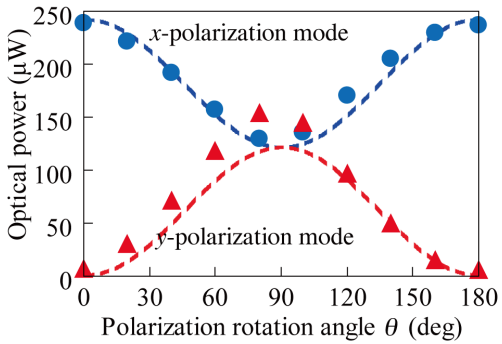

Fig. 3. Measured optical powers of the *x*-polarization (circles) and *y*-polarization (triangles) modes of the VCSEL against polarization-rotation angle of the optical feedback. Dashed curves show theoretical prediction.

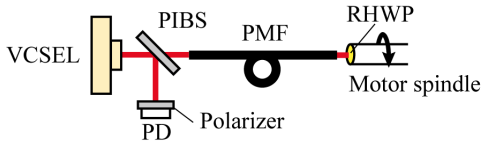

Fig. 5. Proposed concept of rotation sensing system using a VCSEL with optical feedback.

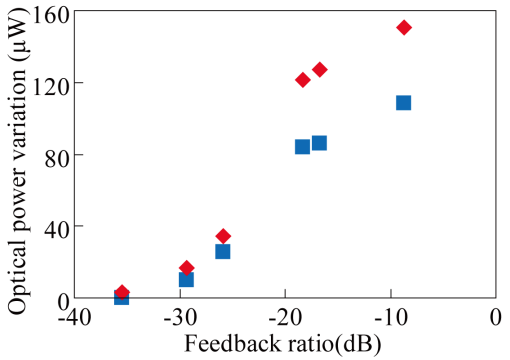

Fig. 4. Measured optical power variations of the x-polarization (squares) and y-polarization (rhombi) modes of the VCSEL against optical feedback ratio.

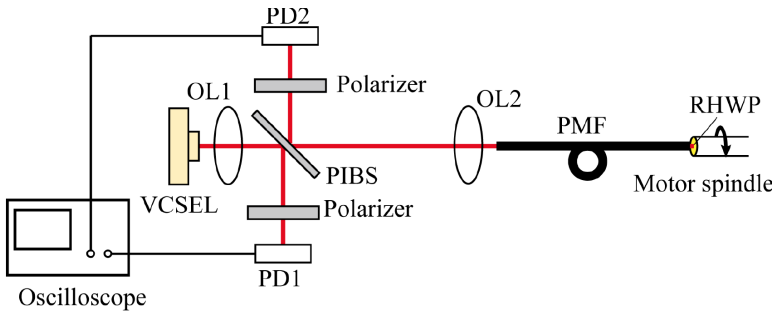

Fig. 6. Experimental setup for measuring feedback optical power and VCSEL power.

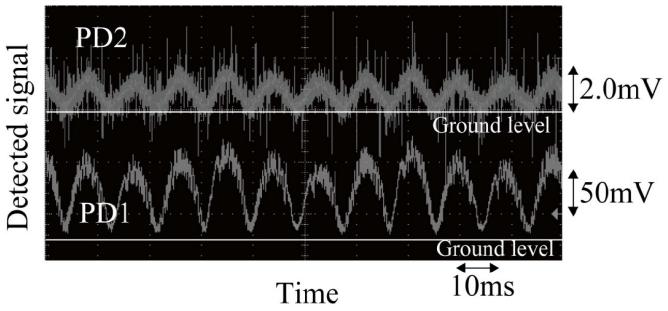

Fig. 7. Obtained output signals from PD1 (lower side) and PD2 (upper side).