Temporal coherence of a SLD system with optical feedback

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High output power and large optical bandwidth are key features for the superluminescent diode (SLD), and the extremely high optical gain in SLD active region may result in very high optical power sensitivity to external optical feedback. Thus, once stimulated emission due to optical feedback occurs, the output light intensity could be increased to achieve optical amplification, and the evident variation of the spectrum shape and temporal coherence could also be observed.

We construct a SLD system subjected to an external optical feedback mechanism (Fig. 1), and then utilize a Michelson interferometer in the output arm to observe the scanned interference patterns. Then, we explore the temporal coherence characteristics of the output light of the SLD system with different optical feedback ratios. This tunable light source system can provide more insights into the optical coherence or lasing phenomena.

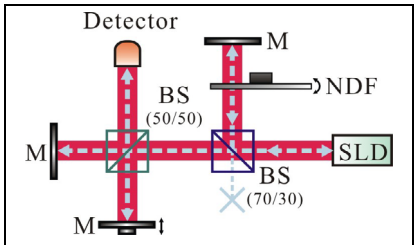

Fig. 1. Experimental setup. BS, beam splitter. NDF, neutral density filter. M, mirror.

In Fig. 2(a), there is the long-scan-range interference pattern of the spontaneous emission light of SLD without external optical feedback. The value of wave packet separation is 1.036 mm, which equals the effective cavity length of the SLD active layer. The interference pattern of the stable laser output (stimulated emission) of SLD system with an optical feedback ratio at 0.25 has doubled multiple wave packets due to longer temporal coherence length [Fig. 2(b)]. The interference pattern for 0.37 feedback ratio has a separation of wave packet similar to the case without feedback, but has a broader expansion of multiple wave packets due to higher optical power [Fig. 2(c)]. Hence the temporal coherence (or the spectral width) of the narrowband output light of the SLD system can be tuned by varying the feedback ratio.

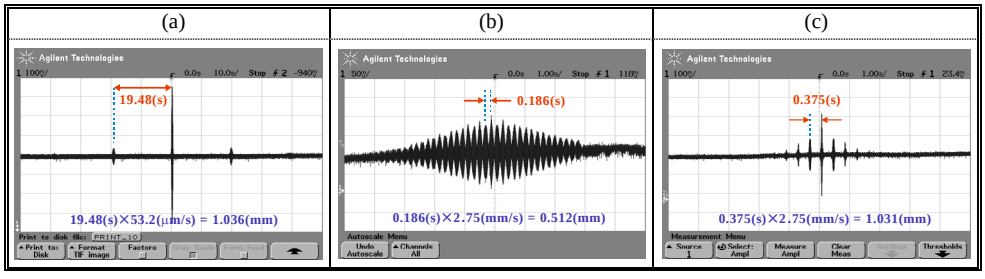

Fig. 2. The scanned interference patterns of the SLD system with different external optical feedback ratios: (a) 0, (b) 0.25, and (c) 0.37, by a digital oscilloscope.

References

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