InAs/GaAs 量子ドットレーザの戻り光耐性

Optical Feedback Sensitivity of InAs/GaAs Quantum Dot Lasers

○Timothy Rae[1]、田辺 克明[1] 、屋敷 健一郎[2]、蔵田 和彦[2]、岩本 敏[1]、荒川 泰彦[1]

(1. 東大ナノ量子機構, 生研、2. 技術研究組合光電子融合基盤技術研究所)

○**Timothy Rae[1], Katsuaki Tanabe[1], Kenichiro Yashiki[2], Kazuhiko Kurata[2] , Satoshi Iwamoto[1], Yasuhiko Arakawa[1] (1. NanoQuine, IIS, Univ. Tokyo, 2. PETRA)**

E-mail: timrae@iis.u-tokyo.ac.jp

Since the proposal of quantum dot (QD) lasers by Arakawa and Sakaki in 1982 [1], there has been an impressive amount of R&D, culminating in the recent commercialization by QD Laser Inc. Although the sensitivity of QD lasers to optical feedback has been previously investigated [2], further theoretical and experimental analysis is required for recent applications such as silicon photonics, where back reflections from optical waveguides can significantly degrade the signal-to-noise ratio of modulated diode lasers unless expensive optical isolators are used. As a first step, in this work we present measurements of the relative intensity noise (RIN) spectrum of a QD laser under varying amounts of optical feedback and injection current. The peak RIN of our sample was measured to be ~20dB/Hz lower than an off-the-shelf Fabry-Perot quantum well (QW) laser.

We measured the RIN spectrum for a QD laser with a wavelength of 1.3 μm processed into a ridge waveguide structure, with cavity length of 375 μm, and reflectivity of 34% and 94% for the front and back facet respectively. The sample was bonded onto a heat-sink mount for good thermal dissipation, and coupled into a single-mode-fiber-based variable back reflector. The reflector was adjusted to send from -65 dB to -22 dB of the light output from the device back into the device, with an external cavity length of approximately 5 meters. A fraction of the light from the single mode fiber was coupled into a high speed InGaAs photodetector, the electrical output of which was amplified and input into an electrical spectrum analyzer.

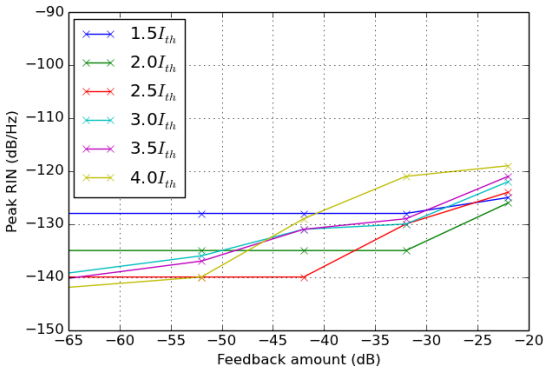

Fig.1 Peak RIN vs optical feedback for QD laser at currents between 1.5 and 4x the threshold current I_{th}.

As shown in Fig. 1, the maximum value of the peak RIN for the QD laser under all testing conditions was < -120 dB/Hz, and in most cases was lower than the noise floor of the measurement system. In contrast our reference Fabry-Perot QW laser (see Fig. 2) had a maximum peak RIN of approximately -100 dB/Hz under similar conditions. Our result demonstrates a significant advantage for the feedback sensitivity of QD lasers over QW lasers. The temperature dependence and theoretical considerations will also be discussed.

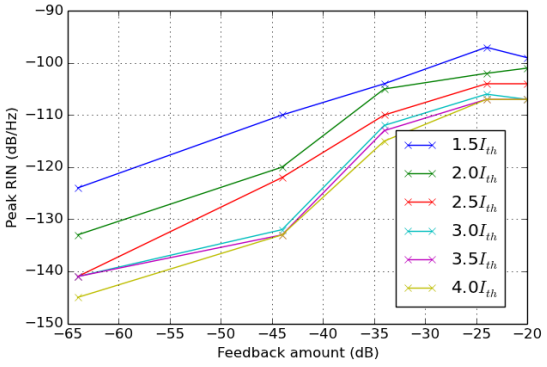

Fig.2 Peak RIN vs optical feedback for QW laser at currents between 1.5 and 4x the threshold current I_{th}.

This research is partly supported by NEDO and MEXT.

[1] Y. Arakawa and H. Sakaki, Appl. Phys. Lett. **40**, 939 (1982).

[2] D. O'Brien, *et al.*, Electron. Lett. **39**, 1819 (2003).