N-P08

Measurement of Optical Gain and α-Factor in Chirped InAs Quantum Dot Laser Diodes

K. C. Kim[1,2], Y. C. Yoo[2], I. K. Han[2], J. I. Lee[2], and T. G. Kim[1]

[1]School of Electrical Engineering, Korea University, [2]Korea Institute of Science and Technology

Semiconductor laser diodes (LDs) based on quantum dot (QD) structure have numerous advantages of device performance regarding ultralow threshold current, large differential gain and high characteristic temperature. However, all of these advantages have not been demonstrated due to the low density of QDs and their size fluctuation. One of the most important parameters in LDs is the linewidth enhancement factor (α-factor), which is defined as the ratio between the carrier-density induced change of the refractiveindex and gain. α -factor affects not only the linewidth of LDs under continuous wave (CW) operation but also the frequency chirp under high-speed current modulation. In addition, a high value of α-factor leads to self-focusing and therefore to filamentation, which limits the performance of high-power LDs. In general, α-factor of quantum well based LDs is usually reported to be above 1. Theoretically, the QD nano structure based LDs havea large material differential gain, zero carrier-induced refractive index change and a zero α-factor at a wavelength of the gain peak position due to their delta-function-like density of states giving rise to a symmetric gain spectrum. However, ideal QD optical performance is difficult to obtain since the inhomogeneous broadening arising from QD size fluctuation and excited state transitions alter the gain profile. Although a few groups recently reported α-factor indicated values of below 1 in QD LDs, a detailed experimental investigation of α-factor is still missing.

In this work, we have experimentally investigated the optical gain and the α-factor in InAs/GaAs QD ridge LDs by measuring amplified spontaneous emission spectra. We will discuss the effect of the optical gain and the α-factor on the filamentation by using QD structures and details on the device performance of InAs/GaAs QD LDs.