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Quantum-dot/dash semiconductor coherent comb lasers with applications in state-of-the-art optical and wireless networks

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Quantum-Dot/Dash (Qdot/dash) chip-scale optical frequency comb (OFC) lasers are promising compact solutions to generate low timing jitter and high spectrum efficient optical pulses for applications in wavelength/freqency-division multiplexing with advanced modulation formats [1]. In this paper, we present semiconductor Qdot/dash C-band single-section passively mode-locking based broadband OFC lasers with mode spacings from 10 - 90 GHz. The laser active gain material is five-stacked-layer InAs Qdots or Qdashs embedded in InGaAsP waveguide core with the average density of 3.5 × 1010 cm−2 in each layer. The performances of lasers are investigated in detail. Typically, we acheived the average RIN value as low as - 133.54 dB/Hz and the phase noise less than 1.5 MHz for each filtered individual mode with total 56 channels for a Qdot laser with mode spacing of 28.4 GHz. Moreover, a pulse-to-pulse timing jitter of 2.1 fs and pulse-to-clock timing jitter of 564.8 fs with integrated frequency range from 35 kHz to 20 MHz are obtained [2]. By employing this ultralow noise and timing jitter laser with 56 wavelength channels as optical carriers, 12.5 Terabit/s aggregate data transmission capacity is demonstrated with dual-polarization 16 QAM and base modulation rate of 28 GBd over a 100 km standard single-mode fiber. In addition, using a Qdash double wavlength DFB laser, we successfully demonstrate various real-time broadband optical heterodyne synthesizer based millimeter wave-over-fiber wireless links featuring multi-Gb/s data rates with a maximum data capacity of 36 Gb/s (64-QAM × 6-GBaud) having EVM and BER below the standard 7% overhead FEC limit of 3.8 x 10-3[3]. These performances are obtained without any form of feedback to control the laser linewidths. These results may lead to an important step towards small size, cost-efficient, low noise, low timing jitter, and a high number of multi-channel light sources for advanced optical and wireless networking systems with upto the capacity of Terabit/s or even higher.

Biography

Youxin Mao completed his PhD and postdoctoral studies from Lancaster University, UK, in 1995 and 1997. She was a Lecturer in Electr. Eng. Dept., Tianjin University, China, from 1985 to 1992. From 1997 to 1999, she was a NSERC visiting fellowship with National Research Council in Canada. As a Research Scientist, she worked in JDS Uniphase from1999 to 2003 and University of Toronto from 2003 to 2006. Since 2006, she has been a senior Research Officer with National Research Council Canada. She is the author of over 180 peer reviewed articles. Her research interests include ultra-low timing jitter quantum-dot mode-locked semiconductor lasers, coherent optical and wireless networks, high speed and high power wavelength swept laser, semiconductor laser package, fiber optics, ultra-small optical fiber probes, and optical coherence tomography.