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Improved Small-Signal Characteristics of Infrared 850 nm Top-Emitting Vertical-Cavity Lasers

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Abstract : High-speed infrared vertical-cavity surface-emitting laser diodes (VCSELs) with Cu-plated heat sinks were fabricated and tested. VCSELs with 10 mm aperture diameter and 4 mm of electroplated copper demonstrated a -3dB modulation bandwidth (f_{-3dB}) of 14 GHz and a resonance frequency (f_R) of 9.5 GHz at a bias current density (J_{bias}) of only 4.3 kA/cm², which corresponds to an improved f_{-3dB}²/J_{bias} ratio of 44 GHz²/kA/cm². At higher and lower bias current densities, the f_{-3dB}²/ J_{bias} ratio decreased to about 30 GHz²/kA/cm² and 18 GHz²/kA/cm², respectively. Examination of the analogue modulation response demonstrated that the presented VCSELs displayed a steady f_{-3dB}/ f_R ratio of 1.41±10% over the whole range of the bias current (1.3I_{th} to 6.2I_{th}). The devices also demonstrated a maximum modulation bandwidth (f_{-3dB max}) of more than 16 GHz at a bias current less than the industrial bias current standard for reliability by 25%.

Keywords : current density, high-speed VCSELs, modulation bandwidth, small-signal characteristics, thermal impedance, vertical-cavity surface-emitting lasers
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