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PAPER ABSTRACT

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Paper Title : "A Laterally-Coupled Single-Mode Distributed Feedback Ridge Laser Diode"

Category: Lasers and Laser Systems

Description : A novel technique to achieve stable single-mode oscillation laser diodes that eliminates the need for epitaxial regrowth has been developed and demonstrated at JPL. This technique is applicable to many different material systems and lasing wavelengths and holds advantages in the manufacturability and reliability of the devices since it requires only a single growth step. Stable single-mode distributed feedback (DFB) laser sources are important in many applications including spectroscopy, pump sources for amplifiers and solid-state lasers, and use in coherent communication systems. To achieve stable single mode operation a periodic change in the refractive index or gain is incorporated along the laser cavity to supply selective feedback. This usually requires an interrupted growth - i.e. regrowth over a grating structure - in the fabrication, which is time consuming and can introduce defects at the grating/regrowth interface. Determining the proper surface preparation and growth parameters to achieve high quality epitaxial regrowth while preserving the grating structure is technically demanding - particularly for short wavelength devices with high Al content and long wavelength GaSb based devices. By etching the gratings into the top surface along both sides of the ridge and relying on the lateral coupling of

the evanescent electromagnetic field stable single mode operation has been acheived without regrowth.

Laterally-coupled distributed feedback laser diodes were fabricated from an MBE grown lnGaAs-GaAs-AIGaAs single quantum well GRINSCH structure. Two pm wide ridges were formed in the upper cladding layer by standard photolithography and chemically assisted ion beam etching (CAIBE). Electron beam lithography was then used to define first order gratings (pitch - 1400Å) into PMMA along both sides of the ridge. CAIBE was then used to transfer the grating 800 Å into the cladding layer. A self-aligned process was used to passivate the gratings and allow contact to the ridge. A CW room temperature threshold current of 8 mA and slope efficiency of 0.43 mW/mA per facet was achieved for 500 µm cavity length LC-DFB with as-cleaved facets. Single-mode output powers of greater than 20 mW per facet with a sidemode suppression ratio (SMSR) of > 30 dB were achieved from 1.5 mm cavity LC-DFBs lasing at 937 nm. A temperature sensitivity of 0.63 Å/°C was measured for a 1 C-DFB compared to 3.0 A/°C for a Fabry-Perot device from the same wafer.