Continuous wave room temperature operation of the epitaxially regrown GaSb-based diode PCSELs.

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Photonic crystal surface emitting laser (PCSEL) device architecture can dramatically improve brightness of semiconductor laser sources. The development of the PCSELs within nitride [1], arsenide [2], phosphide [3], and antimonide [4] material systems is subject of active research to enable high power high brightness surface emitting diode laser operation from UV to mid-infrared. One of the key technological challenges associated with PCSEL development is integration of the high-index-contrast photonic crystal layer into laser heterostructure. The air-pocket-retaining epitaxial regrowth [5] was shown to be effective technique which yielded high-power diode PCSELs. The air-pocket-retaining regrowth within antimonide material system was explored by our research group.

We report on the continuous wave (CW) room temperature operation of epitaxially regrown monolithic GaSb-based ~2 µm diode PCSELs. The devices are based on laser heterostructure containing carrier stopper layer designed to inhibit electron carrier leakage into buried photonic-crystal section. Atomic hydrogen cleaning of the nanopatterned surface followed by optimized epitaxial step resulted in highly uniform air-pocket-retaining regrowth. The laser heterostructure with buried high-index-contrast photonic crystal layer generated about 10 mW of power near 2 µm in CW regime and tens of mW in 5% duty cycle at 20 ^{o}C.

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