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Reduced Contact Resistance in Quantum Cascade Lasers[1]
MATTHEW ESCARRA, SCOTT HOWARD, ANTHONY HOFFMAN, CLAIRE GMACHL, Princeton University — Quantum cascade (QC) lasers have shown tremendous potential as powerful and compact mid-infrared light sources. However, improvement in the high-efficiency operation of these devices must be made for their transfer to real-world utilization. The internal, current, voltage, and optical efficiencies all must be maximized. In particular, high voltage efficiency requires minimizing the voltage defect in the quantum design and parasitic voltage dropped elsewhere in the device. The majority of this parasitic voltage lies in the metal-semiconductor contact junctions. To study this contact resistance, we designed and fabricated a QC laser structure without the active lasing region. Rapid thermal annealing (RTA) on this "empty" structure shows a 35.2% reduction in contact resistance at room temperature, which would correspond with a 7% improvement in laser wall-plug efficiency. Different annealing conditions were tested in order to optimize this reduction. Varying contact metallization and top growth also holds the potential for further reduction in contact resistance and improvement in QC laser efficiency.

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