What Is the Wavelength Limit for Operation of Type-I Electrically Pumped Heterolasers?

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It was not so long ago that type-I QW heterostructures were considered unsuited cw lasers operated at room temperature in the spectral region above 2 μm. Since the development of these bipolar devices required the use of low bandgap materials, it was assumed that the rise of the intensity of Auger recombination would suppress lasing and make high power cw room temperature operation impossible. Then, new devices designed on type-II heterostructures (3-5 μm)[1] and unipolar QCL lasers (4-24 μm)[2] were developed for the infrared region. Type-II heterostructures allowed for suppression of Auger processes[1] while the performance of unipolar intersubband devices is not affected by Auger recombination.

High power cw lasers operated within atmospheric windows I and II (2.3 μm and 3.5 μm correspondingly) are required for a variety of applications including infrared counter-measures. Neither type-II heterostructure lasers, nor intersubband QCL lasers operate in cw mode at room temperature within the above spectral region.

Quite recently it was demonstrated that electrically pumped type-I GaSb based lasers provide hundreds of watts of optical power within the 2.1–2.9 μm spectral range (Figure 1).[3,4] In this paper, the working characteristics of new InGaAsSb/InP based lasers will be discussed and compared with corresponding characteristics of InP-based high power lasers. We will contemplate the future trends in type-I semiconductor laser design and the limits to their long wavelength cw room temperature operation. The authors acknowledge the support from the United States Air Force Office of Scientific Research, grant No. F-49620-01-10108.

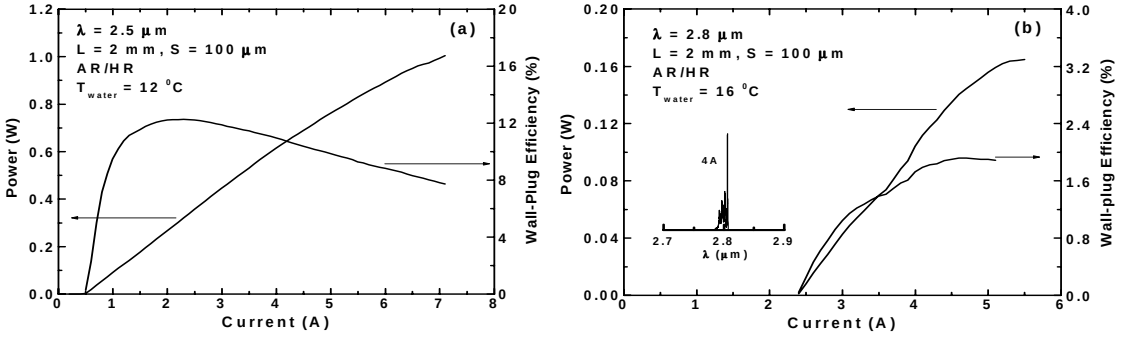

FIG. 1: Continuous wave operation of 2.5 μm (a) and 2.8 μm (b) GaSb-based lasers.

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