Hybrid III-V Silicon Quantum Dot and Quantum Well Lasers

J. E. Bowers, A. Y. Liu, C. Zhang, and A. C. Gossard

University of California Santa Barbara, California, USA
*bowers@ece.ucsb.edu

The silicon photonics field is advancing rapidly, with many new devices demonstrated recently [1]. Demonstrations have shown significantly improved performance that is now approaching that of devices on native InP substrates. In addition to the many passive devices, including AWGs, isolators, and circulators, active devices including lasers, modulators, amplifiers and photodetectors (Fig. 1) are reaching higher levels of integration. Over 60 devices have been integrated onto a single waveguide for applications such as integrated transmitters for datacom and telecom, true time delay PICs for phased array radars, and two dimensional swept transmitters for LIDAR.

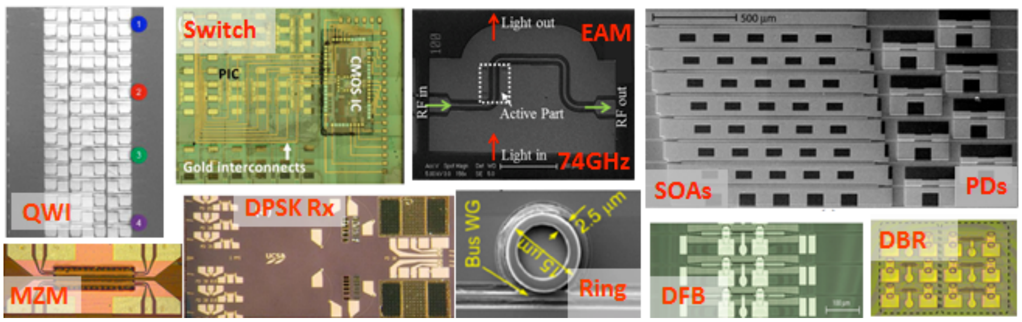

Fig. 1. Examples of hybrid silicon III-V active devices heterogeneously bonded to silicon [1].

Recent work has focused on the epitaxial growth of III-V layers on silicon using intermediate buffer layers, typically Ge and strained superlattices, to minimize dislocations propagating into the active region [2]. The use of quantum dot (QD) laser gain material can minimize the effect of threading dislocations on threshold and power, even after aging. As shown in Fig. 2, these lasers can have low threshold, high power (90 mW CW) and high T_0 (>200K up to 50˚C).

1. M. J. R. Heck, et al., "Hybrid Silicon Photonic Integrated Circuit Technology," *IEEE J. Sel. Top. Quantum Electron.*, vol. 19, no. 4, pp. 6100117–6100117, Jul. 2013.
2. A. Y. Liu, et al., "1.3µm InAs Quantum Dot Ridge Lasers on Silicon", NAMBE (2013).

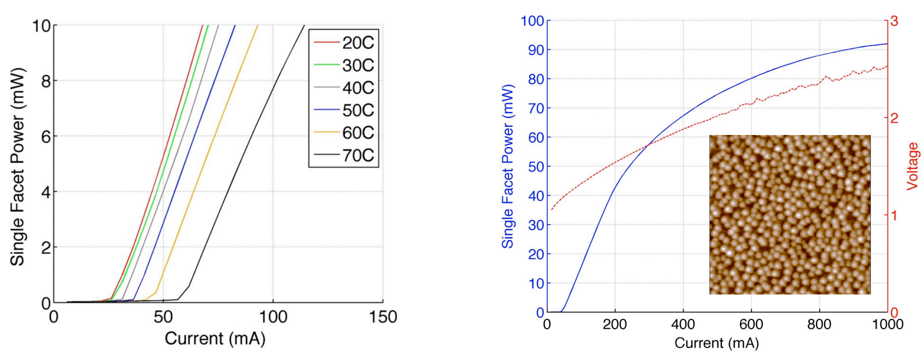

Fig. 2. a) CW LI curves for a quantum dot laser operating CW. b) CW LIV at 20˚C for a 1137x12µm^2 laser. Inset: 1x1µm^2 AFM of a typical dot in well layer(dot density~4.5x10^10 /cm^2).