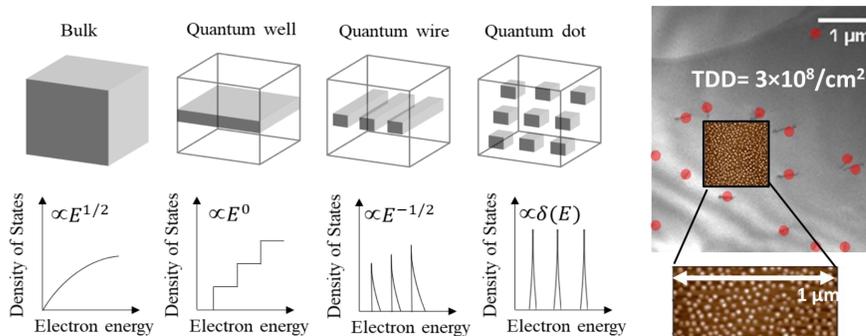


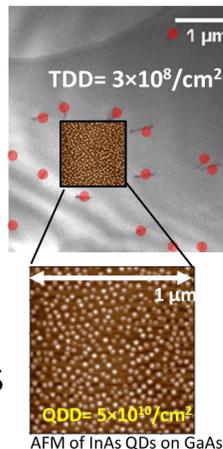
Abstract

Quantum dot (QD) lasers epitaxially grown on silicon have demonstrated records in low threshold, high output powers and high temperature operation among lasers on CMOS compatible on-axis silicon.

QDs instead of QWs as the active region

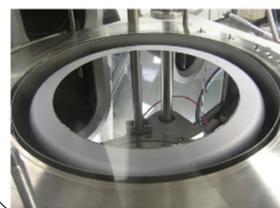
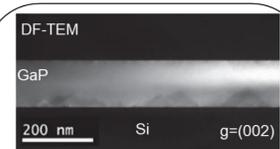


- Zero-dimensional structure, δ -function DOS
- Low threshold, high temperature operation
- In-plane carrier confinement, tolerance to defects



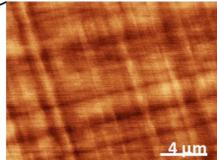
III-V grown on CMOS compatible (001) Si

12 inch GaP/Si wafer

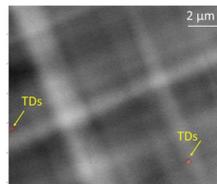


NAsP III/V GmbH

* TDD < $2 \times 10^6 \text{ cm}^{-2}$,
buffer thickness: 2.5 μm

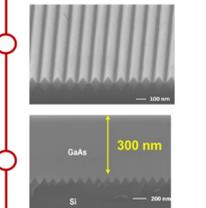
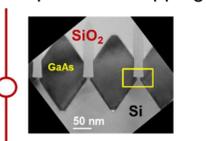


TDD < $3 \times 10^6 \text{ cm}^{-2}$,
buffer thickness: 3 μm



GaAs-on-V-grooved (001) Si

Aspect ratio trapping

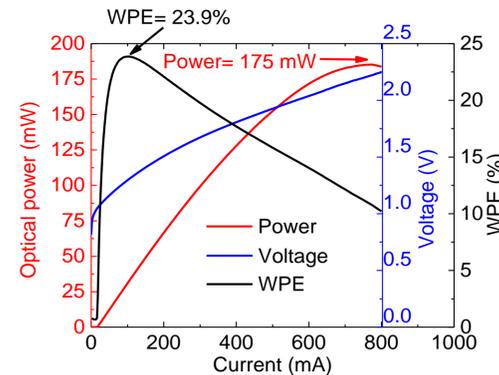
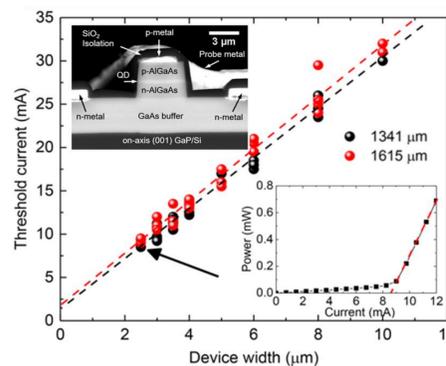


HKUST

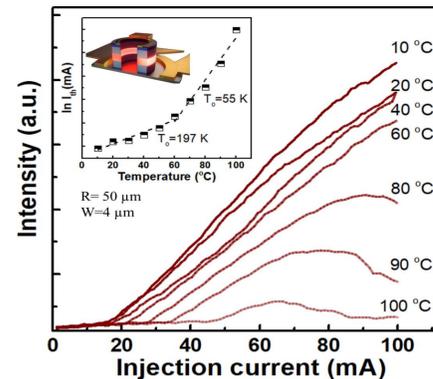
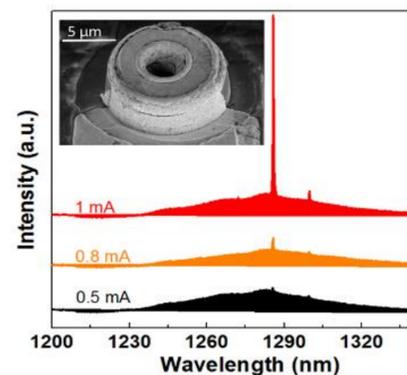
- III-V buffer: TDD < $2 \times 10^6 \text{ cm}^{-2}$, buffer thickness < 2.5 μm
- QD laser epi: PL center: 1285 nm, FWHM: 28 meV, dot density > $5 \times 10^{10} \text{ cm}^{-2}$,

High Performance Lasers

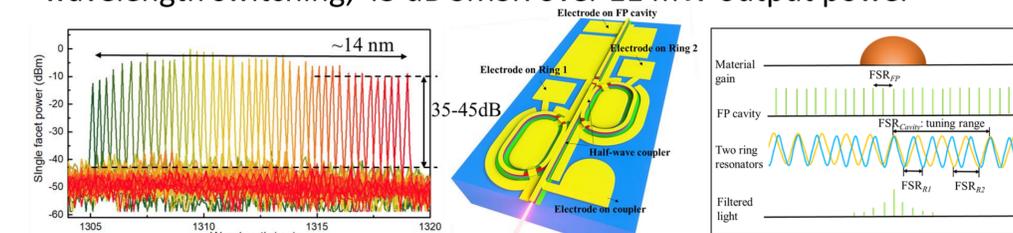
- **Fabry-Perot:** 87% injection efficiency, 175mW output power, 8.5mA threshold current, 119°C continuous wave temperature



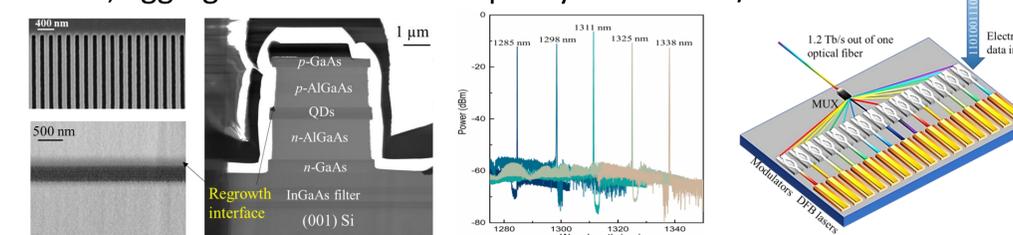
- **Microring Cavities:** 100°C CW temperature, T_0 of 175 K, submilliamp threshold of 0.6 mA



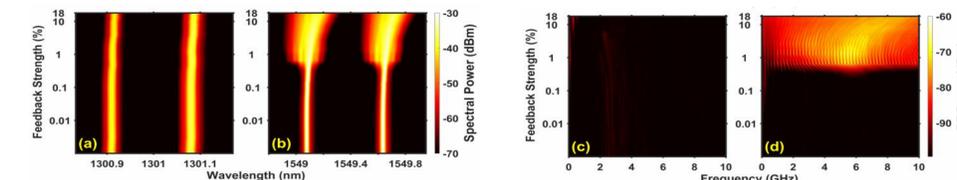
- **Tunable lasers:** no gratings, and no epitaxial regrowth required, 14 nm wavelength switching, 45 dB SMSR over 11 mW output power



- **DFB lasers:** SMSR of more than 50 dB, Threshold 440 A/cm², CW working temperature: 70°C. 53 nm wavelength range, maximum output power 4 mW, aggregate transmission capacity of 640 Gbit/s

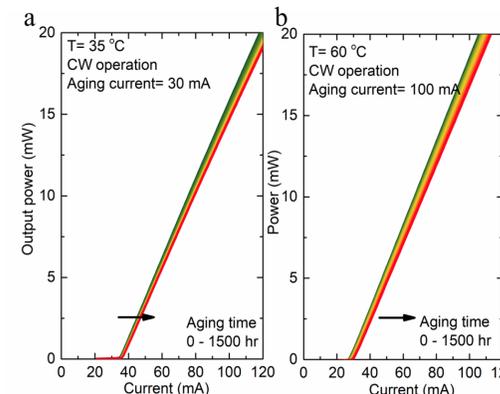
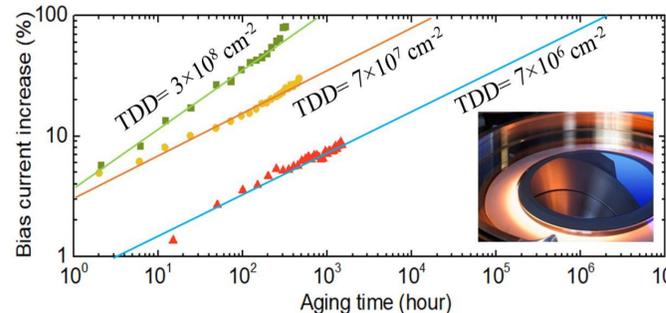


- **High feedback tolerance:** α 15 times lower than QW (~3-5), feedback tolerance, >50 dB increase in the critical feedback level, coherence collapse not occur with 90% of the light reflected back to the laser



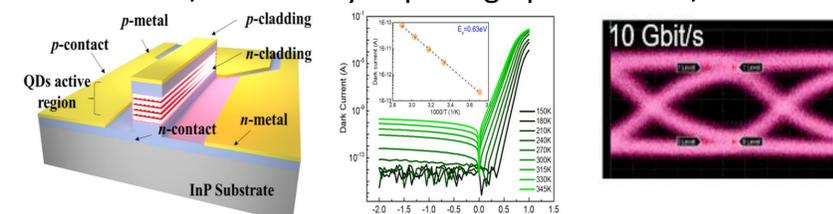
High Device Reliability

- >100 years long lifetime at 35 °C (4000h aging)
- >8 years long lifetime at 60 °C (1500h aging)



Future Prospects

- **Other Ingredients for Photonic Integration**
PD: dark current : 5.3 pA @ -1 V ($3.5 \times 10^{-7} \text{ A/cm}^2$), responsivity values >0.3 A/W. Clear eye opening up to 10 Gbit/s



- **Active-Passive Coupling and Co-Integration**
- **Other working wavelengths (O band \rightarrow C band)**