Long-wavelength fiber-coupled diode laser modules

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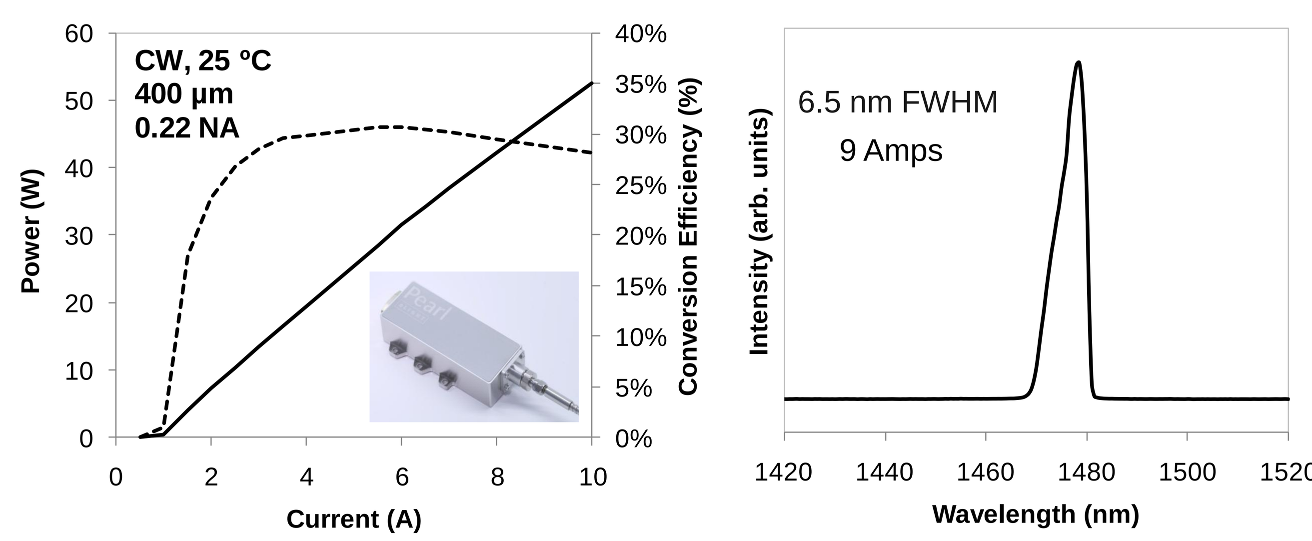
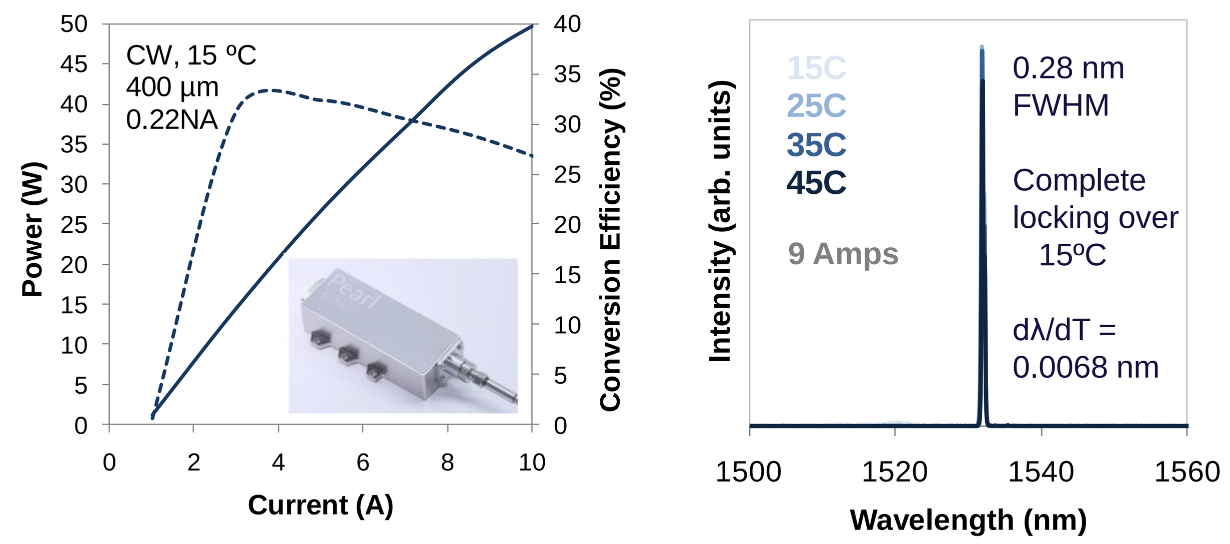
14xx-15xx nm Pearl™ Modules

1. 400-µm, 0.22NA fiber-coupled module performance (unlocked)



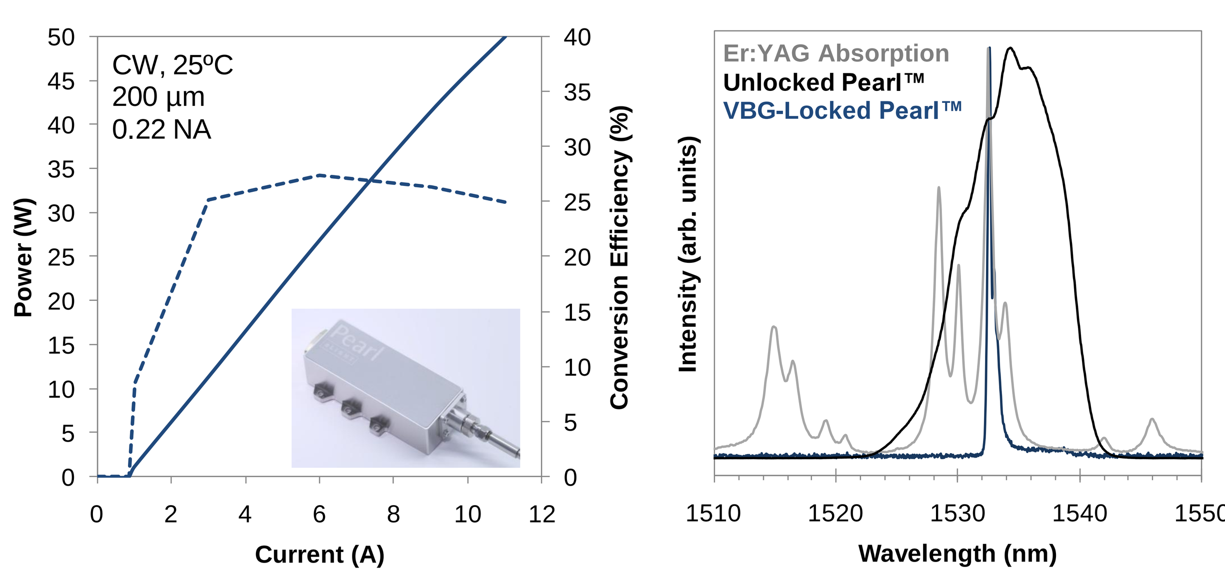
>50W, 29% E/O from 400 µm, 0.22 NA fiber at 1470nm

2. 400-µm, 0.22NA fiber-coupled module performance (locked)



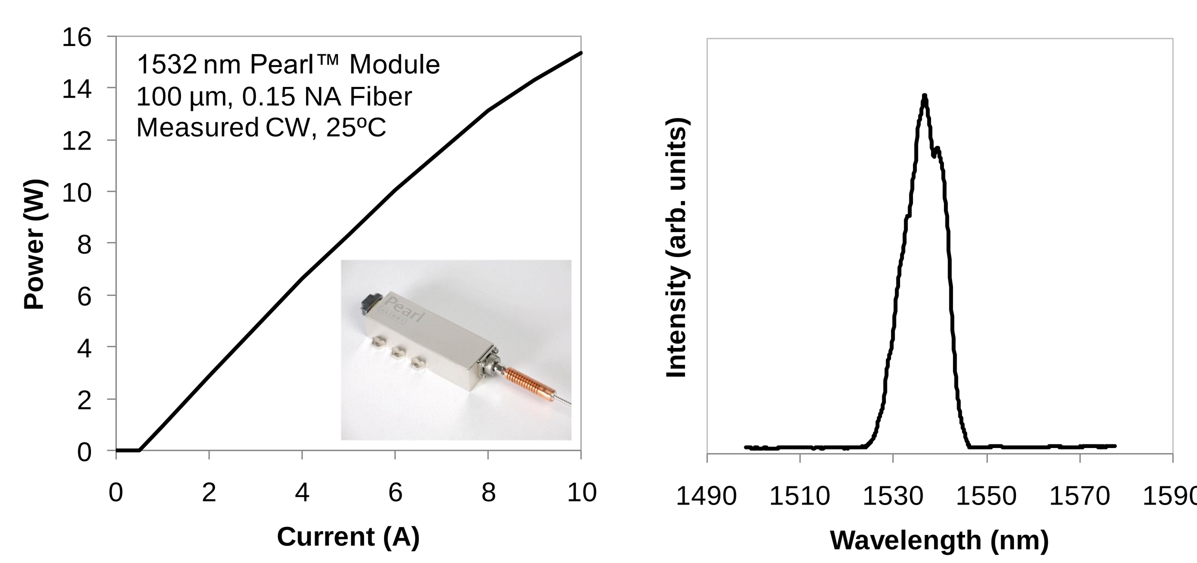
50W, 27% E/O from 400 µm, 0.22 NA fiber,
with <0.3 nm FWHM spectral width at 1532.5 nm

3. 200-µm, 0.22NA fiber-coupled module performance (locked)



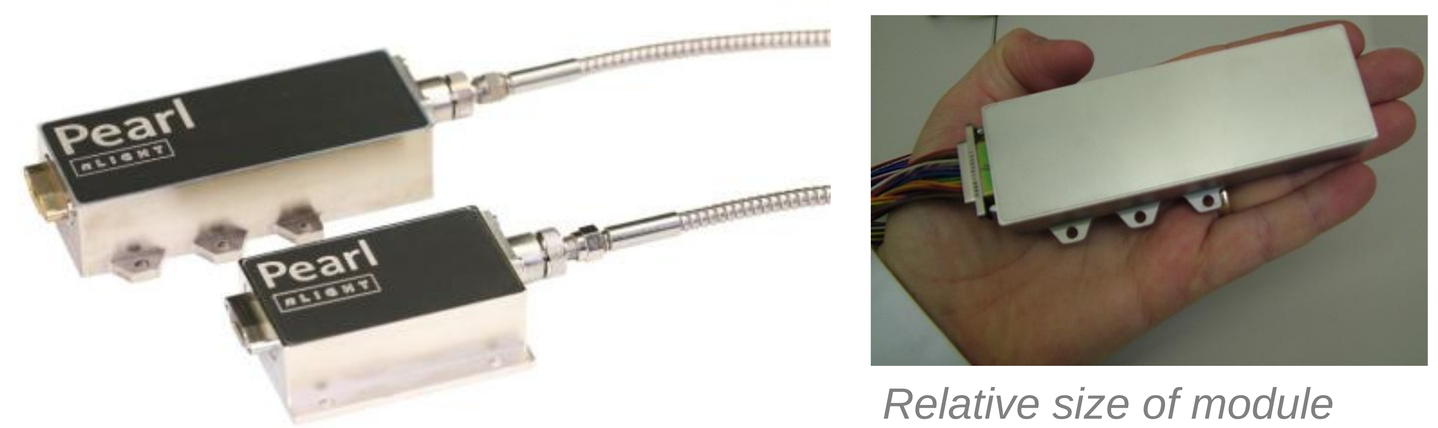
50W, 25% E/O from 200 µm, 0.22 NA fiber,
with 0.34 nm FWHM spectral width at 1532.60 nm

4. 100-µm, 0.15NA fiber-coupled module performance (unlocked)



>15W from 100 µm, 0.15 NA fiber
(Polarization multiplexing provides direct path to >30W)

Pearl™ Conductively-Cooled Fiber-Coupled Modules



Relative size of module

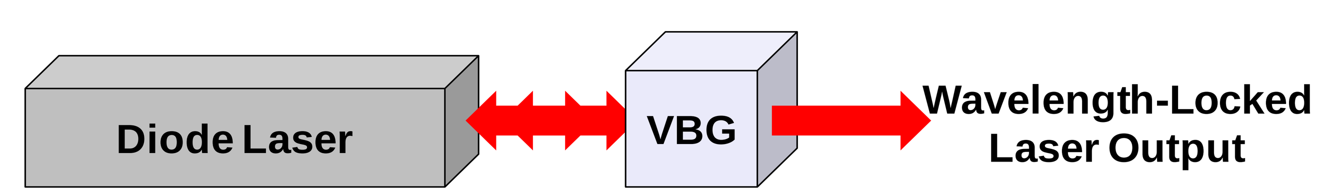
Conductively-cooled fiber-coupled modules based on arrays of hard-soldered single emitters enable rapid brightness scaling. Available at all wavelengths nLight manufactures (6xx-9xx nm and 13xx-20xx nm)

Key Advantages

- Higher linear power density requires fewer emitters to achieve power
- Reduced thermal expansion from smaller chip size gives great on/off reliability
- No smile as with bar-based solutions
- Long MTTF

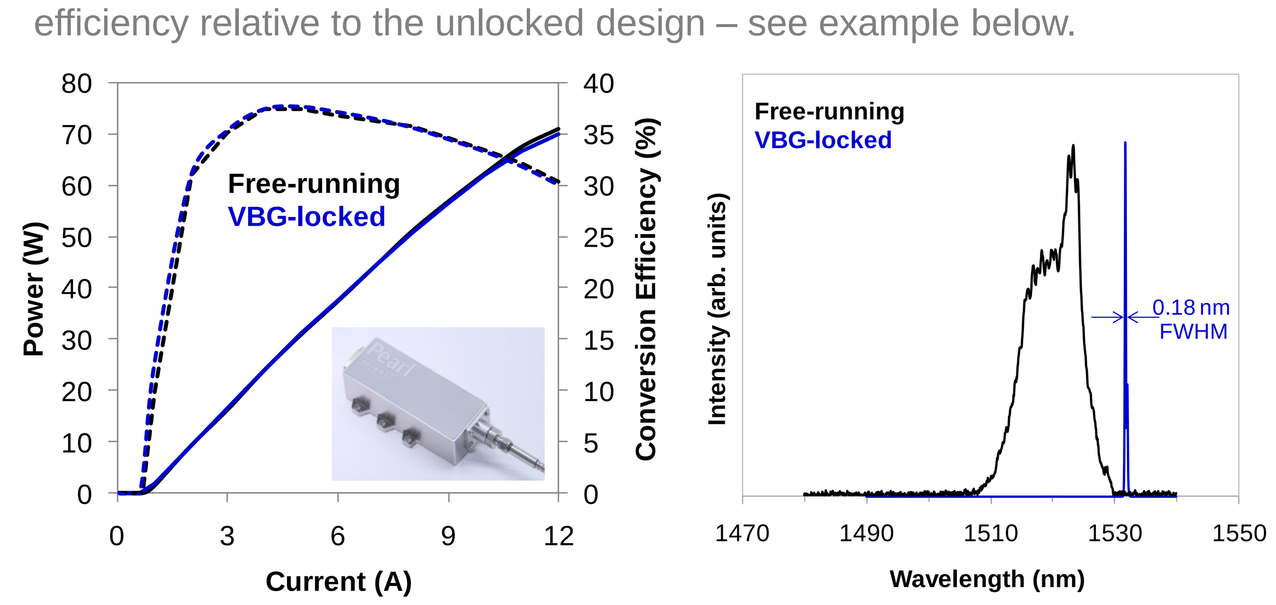
Wavelength-Locking Based on Volumetric Gratings

Efficient laser systems require a diode pump source with emission spectrum that is well-matched to the absorption feature of the solid state or fiber gain medium. Standard broad area diodes lase on all modes which experience sufficient round-trip gain within the spectral bandwidth of the quantum well. This results in an unlocked spectral emission envelope which tracks the optical gain and is therefore wide (and proportional to the square of the emission wavelength). By introducing wavelength-selective feedback to the diode laser, the emission can be locked to a narrow band. nLight's approach utilizes volumetric Bragg gratings as the locking element.



Key Advantages

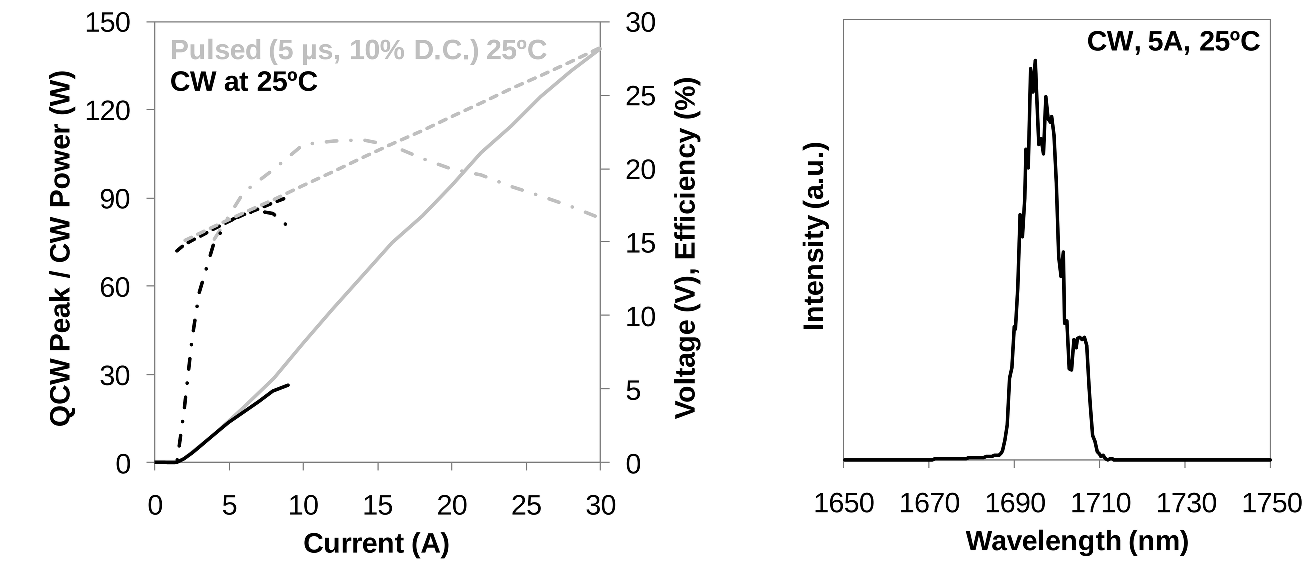
1. Flexibility – Linewidths can be tailored and wavelength changes are easy.
2. Improved yield and reliability, lower cost – External locking eliminates need for epitaxy regrowth and leverages industry-standard lensing techniques.
3. Better temperature stability – The locking optic (having a naturally low $\partial\lambda/\partial T$) is thermally decoupled from the laser diode.
4. Highest power and efficiency – The epitaxy can be independently optimized for high power and high efficiency. The low internal loss of the grating itself allows design optimizations which provide virtually zero penalty in the power and efficiency relative to the unlocked design – see example below.



Wavelength locking can be achieved with virtually
no penalty to the laser efficiency or power!

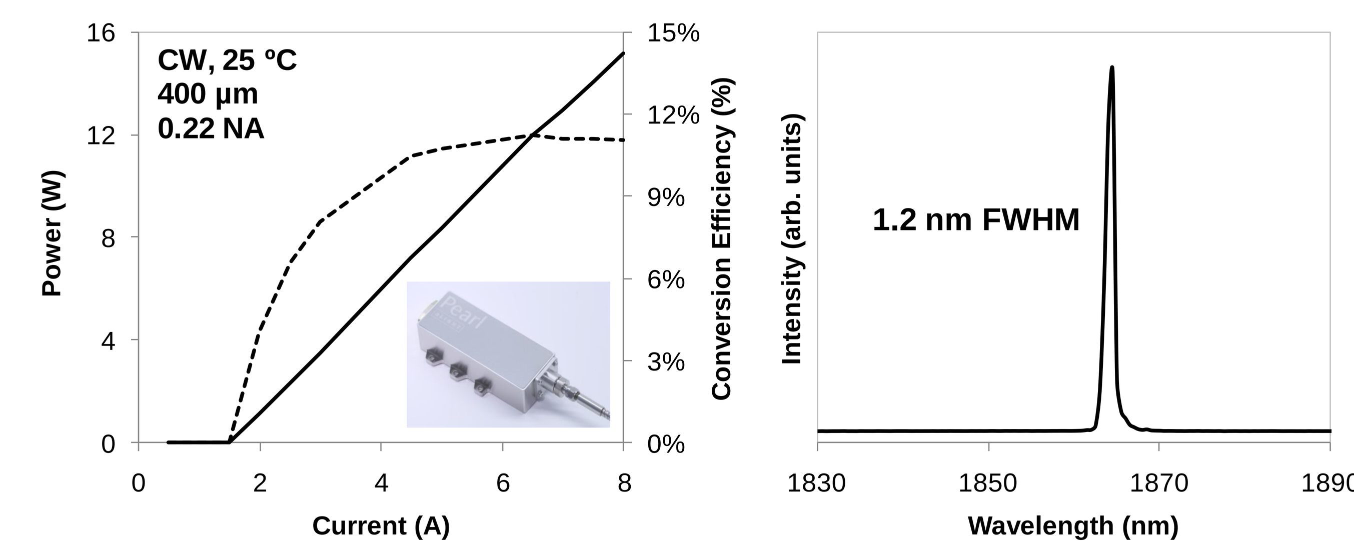
17xx-20xx nm Pearl™ Modules

1. 400-µm, 0.22NA fiber-coupled 1700-nm module (CW vs. pulsed)



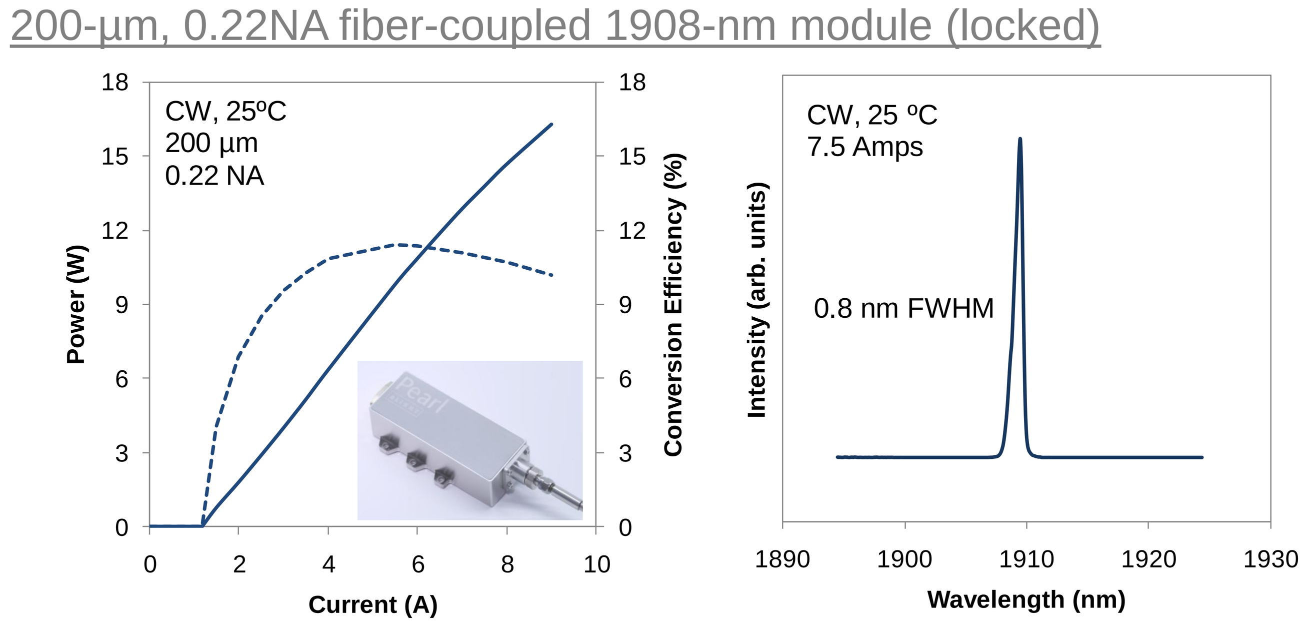
CW: >20W, 16% E/O
Pulsed (5 µs, 10% D.C.): >140W

2. 400-µm, 0.22NA fiber-coupled 1863-nm module (locked)



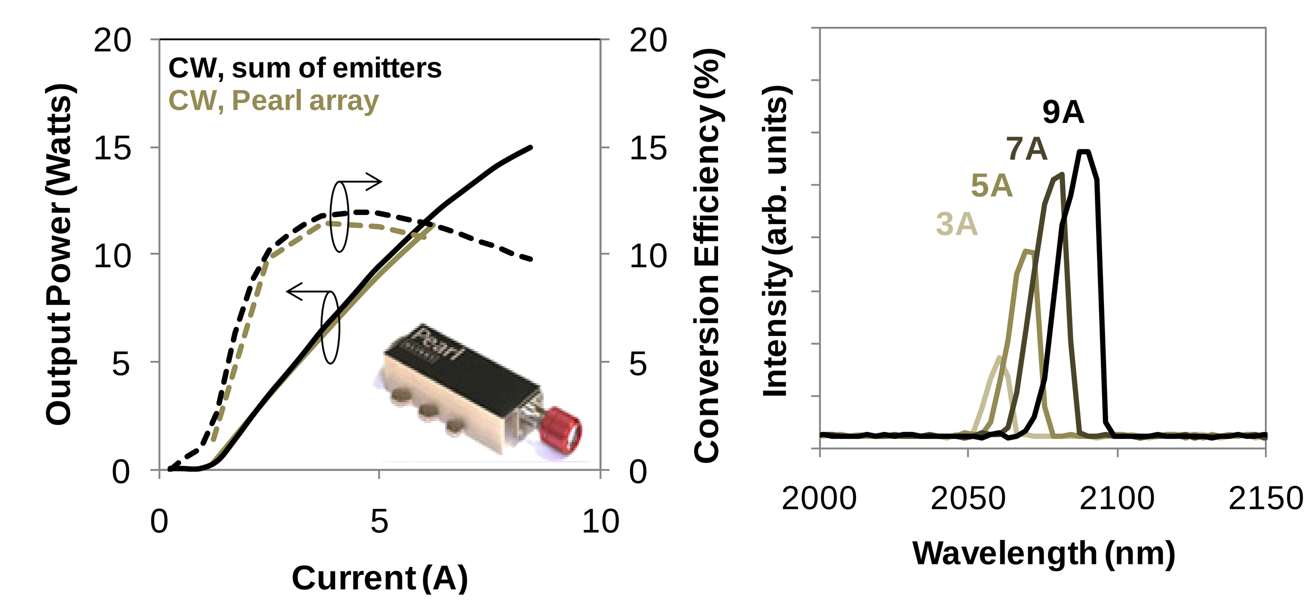
>15W, 11% E/O from 400 µm, 0.22 NA fiber,
with 1.2 nm FHWM spectral width at 1863 nm

3. 200-µm, 0.22NA fiber-coupled 1908-nm module (locked)



16W, 11% E/O from 200 µm, 0.22 NA fiber,
with 0.8 nm FHWM spectral width at 1908 nm

4. Super-collimated 2080-nm module performance



11W, 10% E/O at 2080 nm – 0.96 cm x 4.3 mrad (slow axis) and
0.86 cm x 6.7 mrad (fast axis) → 0.6 MW/cm²-str

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