Advancements in broad-area InP-based diode lasers operating from 1400-nm to >2100-nm

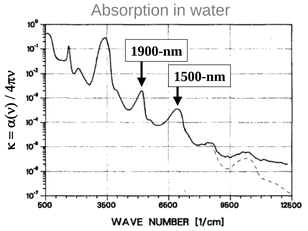
Paul Leisher*, Weimin Dong, Xing Guan, Mike Grimshaw, Jason Patterson, and Steve Patterson

nLight Corporation, 5408 NE 88th St., Bldg. E, Vancouver, WA, USA 98665

1400 to 1600 nm Broad Area Diode Lasers

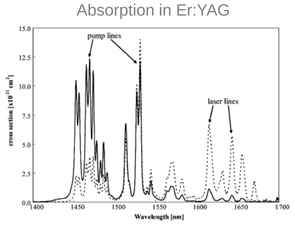
1. Applications

Absorption in water



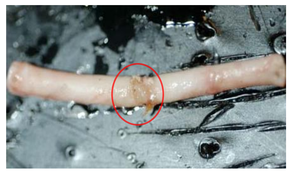
D. M. Wieliczka, S. Weng, and M. R. Querry, "Wedge shaped cell for highly absorbent liquids: infrared optical constants of water," (1989) Appl. Opt. 28, pp 1714-1719

Absorption in Er:YAG



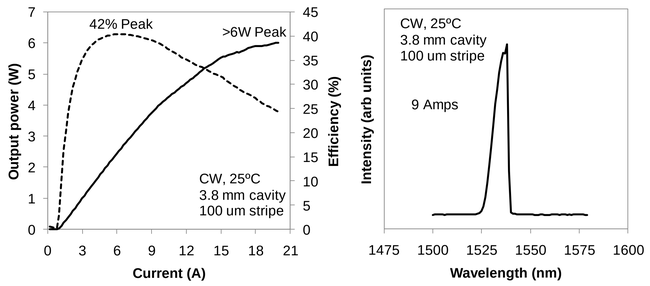
S. D. Setzler, M. P. Francis, Y. E. Young, J. R. Konves, and E. P. Chicklis, "Resonantly Pumped Eye-safe Erbium Lasers," *IEEE J. Sel. Top. Quant. Elect.*, vol. 11, no. 3, pp. 645-657, (2005).

Laser anastomosis of porcine blood vessel



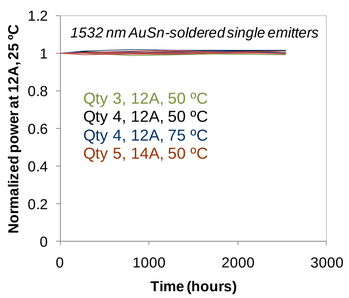
- Medical (tissue welding and ablation)
- Consumer health and beauty
- Direct upper-state pumping Er:YAG for eyesafe LIDAR

2. Hard-soldered single emitter performance



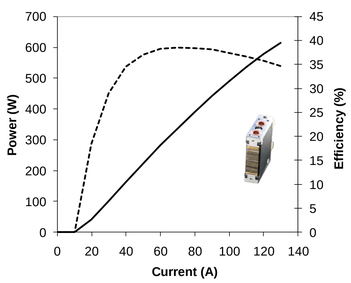
Hard soldered 15xx-nm single emitters now deliver >6W, 42% peak E/O at 25 ºC from a 100 µm stripe

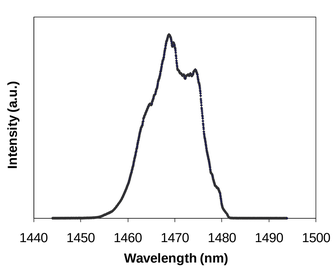
3. Hard-soldered single emitter reliability



>40,000 device hours collected under highly accelerated conditions without degradation

4. Microchannel-cooled stack performance



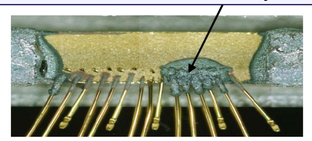


1470-nm 12-bar stack tested CW at 25 C, 0.2-lpm flow operates at >600W, 35% E/O

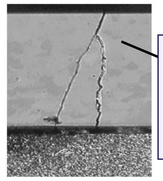
Hard-Soldered InP Diode Lasers at *n*LIGHT

The temperature performance of diode lasers operating beyond 1400-nm is significantly worse than those which operate below 1000-nm due to a variety of reasons, including Auger recombination. As a result, high-power long-wavelength diode lasers have historically relied on In solder in order to leverage high thermal conductivity heatsinks such as Cu. The use of soft solders (such as In) has been shown to have significant negative implications to device reliability. Bonding techniques which rely on hard solders (such as AuSn) can mitigate the hazard, though at a cost to performance due to the required use of heatsink materials which have a coefficients of thermal expansion close to that of InP. nLight's InP diode laser structures are specifically optimized for use in hard-soldered configurations and yield industry-leading performance (power and efficiency) .

Indium creep leading to formation of whiskers on the wirebonds causes early failure

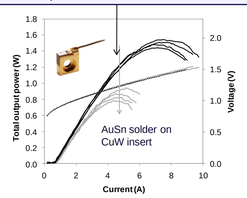


NASA Parts Advisory NA-GSFC-2004-01.



CTE mismatch in hard-soldered diodes can lead to chip cracking

At 1900-nm, a 35% rise in thermal resistance leads to a ~ 50% drop in maximum power



nLight's InP-based long-wavelength diode lasers are specifically optimized to meet the thermal challenges associated with AuSn soldering techniques to deliver industry-leading performance *and* reliability

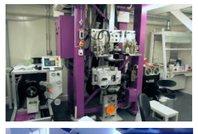
About *n*LIGHT

nLIGHT is a leading supplier of innovative high-power semiconductor lasers and high-performance specialty optical fibers for industrial, medical, defense and consumer applications. nLIGHT partners with customers to provide advantages in performance, reliability and efficiency. Global support is provided through state-of-the-art manufacturing and application centers in North America, Europe, and Asia.

Vancouver, WA
Diode Lasers – Growth and Packaging

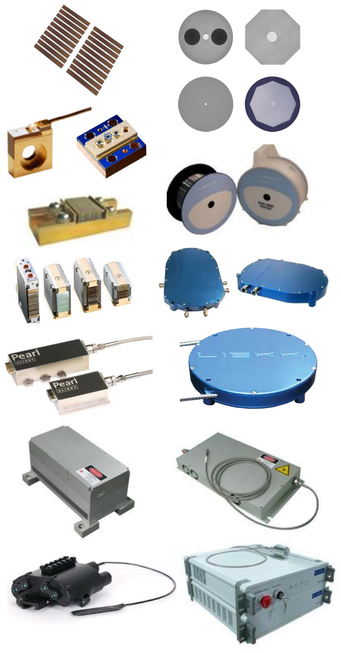
Shanghai, China
Packaging

Hillsboro, OR
Assemblies, Fiber Lasers, EO Systems



Lohja, Finland
Fibers, Components

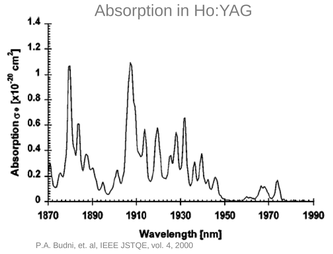
Heilbronn, Germany
Direct Diode Systems



1800 to >2100 nm Broad Area Diode Lasers

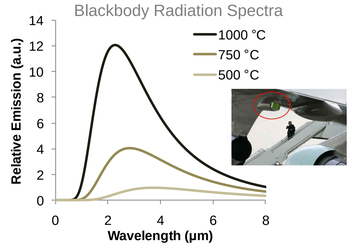
1. Applications

Absorption in Ho:YAG



P.A. Budni, et. al, IEEE JSTQE, vol. 4, 2000

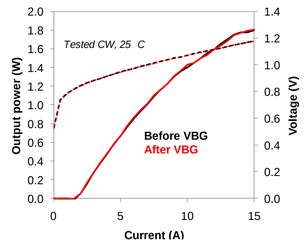
Blackbody Radiation Spectra

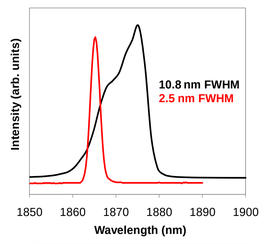


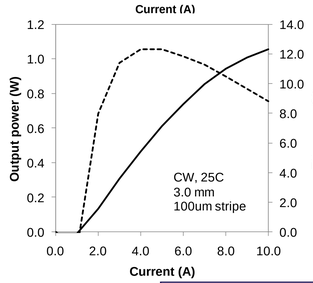
Diode pumping of Ho:YAG at 1.9 µm

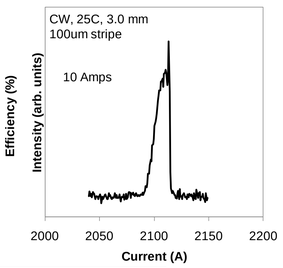
Direct diode IRCM at 2.0 µm

2. Hard-soldered single emitter performance



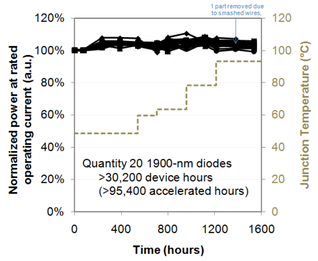






1.8 to 1.9 µm: >1.6W, >15% E/O
2.0 to 2.1 µm: >1.0W, >10% E/O

3. Hard-soldered single-emitter reliability



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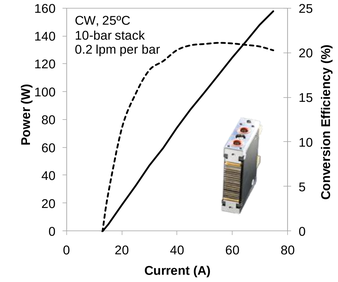

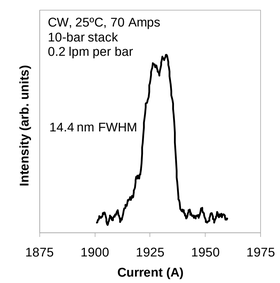

1930-nm 10-bar stack tested CW at 15 C, 0.2-lpm flow operates at >150W, 20% E/O