TeraDiode

Simply Brighter

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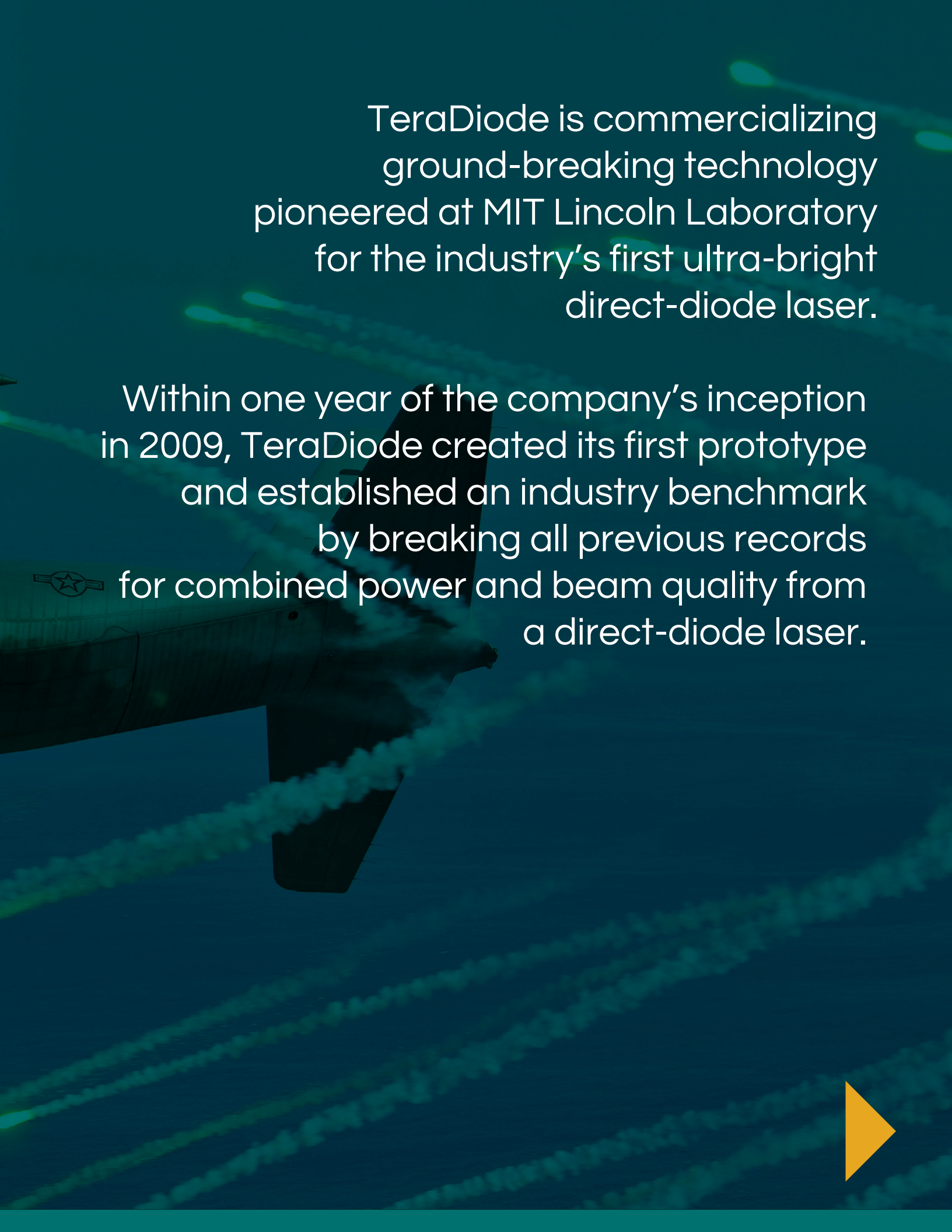


TeraDiode is commercializing ground-breaking technology pioneered at MIT Lincoln Laboratory for the industry's first ultra-bright direct-diode laser.

Within one year of the company's inception in 2009, TeraDiode created its first prototype and established an industry benchmark by breaking all previous records for combined power and beam quality from a direct-diode laser.

Teradiode's Wavelength Beam Coming (WBC) Technology

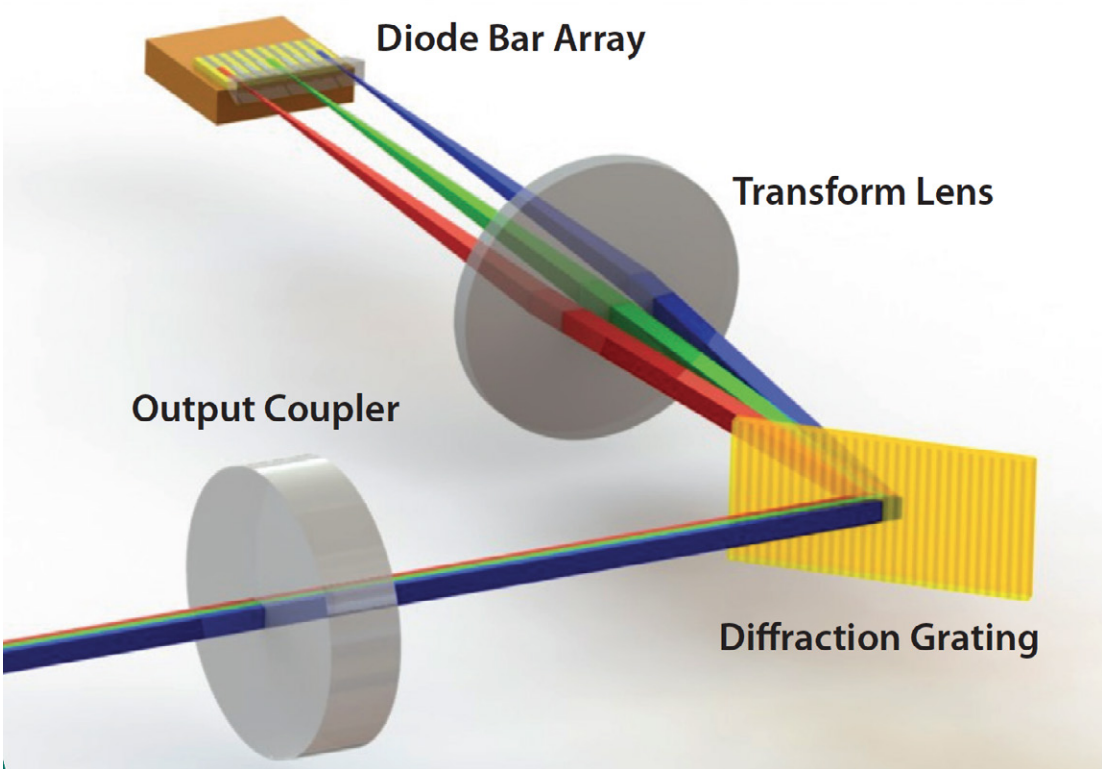
WBC can be thought of as the spatial and directional superposition of many independent diode laser external cavities. The angle-to-wavelength conversion property of a diffraction grating is used to provide feedback to each emitter in an array, via a series of lenses, at different wavelengths. The laser resonator is formed between the HR coated back facet of the emitter and the output coupler. WBC allows for brightness scaling of an emitter array because all of the laser elements are spatially overlapped at the output coupler, maintaining the output beam quality of a single element while scaling the output power by the number of elements in the array.

With this fundamental breakthrough in WBC technology, TeraDiode has developed the first ultra-high brightness, direct-diode lasers that are bright enough to cut and weld metal with performance similar or better than the fiber laser. They combine unprecedented brightness with efficiency, reliability and low cost. At TeraDiode, we believe that direct-diode lasers using TeraDrive™ technology will, in time, replace fiber, disk and other lasers for the most demanding material processing applications. TeraDiode's TeraDrive™ technology is a third generation laser technology with leapfrogs in efficiency, simplicity, and cost of ownership over previous generations.

The TeraDrive™ technology can be applied to any array of laser elements, over a wide range of power and wavelength combinations. TeraDiode has demonstrated WBC using laser diode bars and stacks operating near one micron. Nevertheless, arrays of fiber, solid-state or gas lasers operating at wavelengths from the UV to longwave IR range can also be used.

Disruptive Simplicity

Invented at MIT and Exclusively licensed to TeraDiode



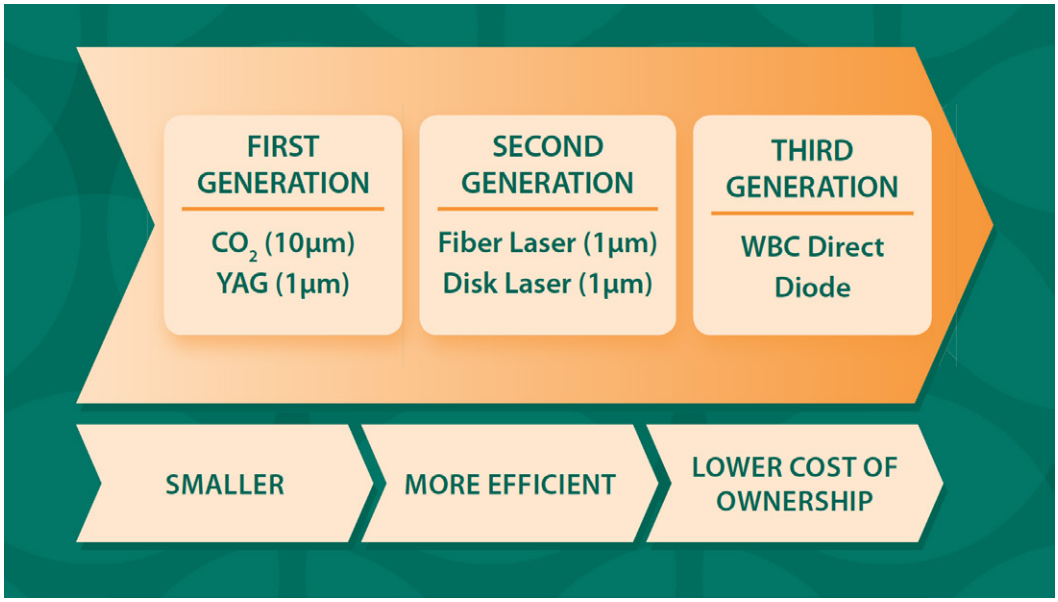


Figure 1 - TeraDiode's Vision of High Powered Lasers

TeraDiode's Vision of High Powered Lasers

Leapfrogs in efficiency and cost of ownership

Visit www.teradiode.com for a complete listing of products

Products

2, 4, 6 and 8kW Direct Diode Laser System at 970nm with 100µm fiber
500 and 1000W Direct Diode Laser Engines at 970nm with 50-100µm fiber High Brightness MWIR Laser System at 4.6µm
MWIR Laser Systems available at wavelengths from 4-11µm

Defense Applications

TeraDiode's ultra-high brightness, direct-diode lasers enable many defense applications, including infrared countermeasures, target designators and directed energy weapons.

For applications using a fiber laser, only TeraDiode's TeraDrive™ technology offers ultra-high spatial and spectral brightness in a single-stage laser. We believe this is the only approach to a 100 kW fiber laser system that can meet the stringent SWaP and reliability demands of defense applications. In addition, the TeraDrive™ technology is highly stable with respect to temperature ($d\lambda/dT$) and power ($d\lambda/dP$). These are required to scale a fiber laser to HEL power levels. For free space applications, TeraDiode can produce a nearly diffraction-limited output that can be scaled to 100 kW and higher power levels. The TeraDrive™ technology is based on more than ten years of government funded research at MIT Lincoln Laboratory which was led in part by two of our co-founders, Dr. Bien Chann and Dr. Robin Huang.

Company Overview

TeraDiode is a spin-off of MIT Lincoln Laboratory and is commercializing kW-class free-space and fiber-coupled direct diode lasers for high brightness applications.

The company's technology, pioneered at MIT Lincoln Laboratory, has broken all records for combined power and beam quality from a direct diode laser. Many experts consider direct diode lasers to be the future of the laser industry.

Key Management

- CEO: Parviz Tayebati
- CTO & co-founder: Bien Chann
- VP defense & co-founder: Robin K. Huang
- Defense Manager: Mike Cruz

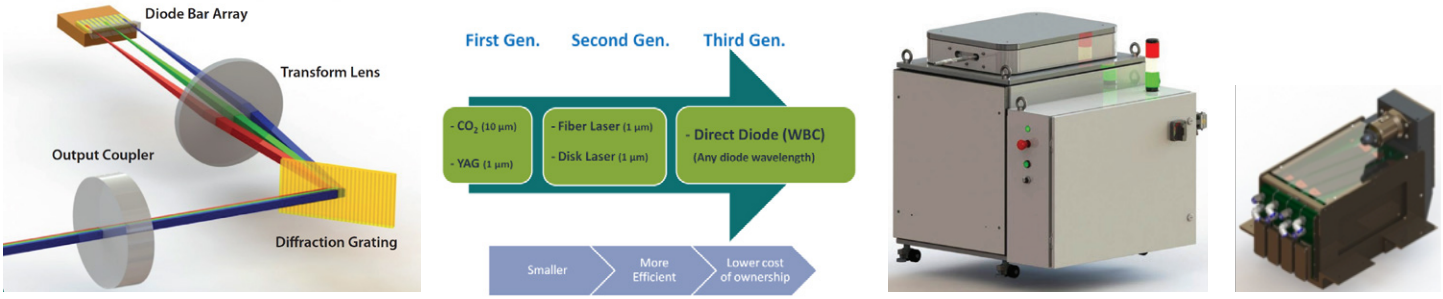
Investors

- Stata Ventures
- Argonaut Ventures
- Camros Capital

80 employees and 24,000 square foot facility in Wilmington, MA

TeraDiode's Highest Brightness Industrial Diode Laser System:

TeraDiode (TDI) has developed direct diode lasers that use 1-D WBC to achieve brightness levels orders of magnitude higher than that of existing commercial direct diode products. Figure 1a shows the basic architecture. An array of diode lasers is placed in an external cavity consisting of a transform lens, a diffraction grating and an output coupler. The output beam quality is ideally that of a single element in the array. The output power is scaled by the num-ber of elements in the array, while preserving the beam quality of a single emitter. TDI has an exclusive license on this technology from MIT. We manufacture direct diode lasers that have comparable beam quality to that of any industrial laser, including fiber lasers and CO2 lasers.



A B C D

Figure 2. (A) Basic architecture of wavelength beam combining. (B) TeraDiode's vision of high power lasers. The direct diode laser with Wavelength Beam Combination (WBC) is the most compact, most efficient, and lowest cost laser. (C) TeraDiode's multi-kW industrial laser platform which will be adapted to meet the requirements of a High Energy Laser. (D) Laser engine for 2-kW laser system consisting of four TeraBlades or diode laser modules.

We have obtained 8 kW from a 100 µm fiber with BPP < 6 mm-mrad, and are commercializing 2-kW, 4-kW, 6-kW, and 8-kW fiber-coupled direct diode laser products (see Figure 2c). These systems are based on a modular (Blade) design (a fiber coupled version is shown in Figure 2d). We have demonstrated up to 510 W in a nearly diffraction limited output beam (M^2~3), corresponding to a brightness of 5,500 MW/cm^2-str. Our lasers are wavelength stabilized with measured wavelength shift with power and temperature of 0.001 nm/W and 0.002 nm/°C, 100x better than COTS fiber-coupled diode lasers. An earlier version of our WBC 480-W laser has been temperature cycled from -20° C to +60° C, and the power remains constant during the multiple temperature cycling.

Figure 1 shows TDI's vision on the future of high power industrial lasers. The first generation industrial lasers are based on CO2 and bulk solid state lasers. These lasers are being replaced by fiber and thin disk solid state lasers. They are brighter and more efficient. Our vision of the next generation laser is direct diode lasers with the same brightness as fiber and thin disk lasers but with higher efficiency and wavelength agility. Figure 2c shows our 2 kW turn-key industrial laser system coupled to 100/0.08 fiber. Figure 2d shows the optical engine, which is composed of four (4) sub-laser engines called TeraBlades. Each TeraBlade outputs 550 to 600 W running at the nominal operating current. The expected lifetime is >20,000 hours.

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