THE FUTURE FOR FIBER AND DISC LASERS

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DISRUPTIVE TECHNOLOGIES

Fiber lasers (FL) and the disc laser have the potential to be a disruptive technology as compared to existing industrial laser technology, such that when the fiber or disc technology is perfected, it will displace 40% of the existing industrial lasers sold. This assumes the existing technology to manufacture fiber lasers, including low cost pumps, is fully perfected. However, if low cost pumping technology is developed, so that the initial cost and operating cost are comparable to that of high power CO_2 lasers, these two laser types combined could achieve as high as 60% market share by taking market share away from CO_2 lasers in the sheet metal cutting space. .

Larger size disc lasers are already showing efficiencies comparable to fiber lasers. The newest designs also use reliable non-microchannel cooled diode pump technology. They are fiber delivered with beam parameter products (BPP) of 2 to 8, which is where most of the industrial applications for high power lasers exist.

There is a small group of high power industrial applications where the close to diffraction limited beam from fiber lasers is necessary and in these applications the fiber laser will be the dominate laser type vs. the disc laser.

The direct diode laser, however, will be a strong contender. Its beam quality can approach that of the disc or the fiber laser. For the direct diode laser to substantially impact the market share of the disc or fiber laser it will need to supply a BPP of 6 to 12 .

ADVANTAGES

The advantages of fiber and disc lasers compared to existing technology are:

1. A very stable beam for power, mode and pulse shape.
2. Wide dynamic range with the beam quality basically constant throughout the power range.
3. High “TV set” reliability: run for 10,000’s of hours without service.
4. High efficiency.
5. Ruggedness.
6. Flexible fiber beam delivery.
7. Small size.
8. Application can be located 100’s of meters from the laser.
9. Easily switched.
10. Initial metal cutting tests indicate the fiber laser can cut thin metals (8 mm or less) with 1/3 the power at the same speed thus potentially offsetting the FL higher $/Watt.

DISADVANTAGES

The disadvantages of the fiber laser and disc laser that make other laser types the best choice in specific applications:

1. Only a small range of wavelengths is available. Primarily useable for metals. Non-metals generally cannot be processed. UV wavelengths not available.
2. The lowest cost Yb FL is not eye safe and requires special glasses. The "eye safe" Er FL is as good as the CO_2 however in industrial Class 4 environments (no enclosure e.g. typical sheet metal cutters.) the Er FL will still require special glasses to be worn anywhere within 100 feet or more of the laser.
3. Er FL requires 2X the diodes for the same power thus higher cost for an "eye safe" FL.
4. Limited pulse power. Single mode fiber limit at a 20 kW peak although there are technologies such as photonics crystal fibers that may change this.
5. Little energy storage compared to rod type lasers. Q switching for high pulse power is difficult.
6. Gated pulsing speed limited in standard configurations of 10 to 100 kHz
7. Fiber lasers are difficult to repair in the field and must be shipped back to the manufacturer for rebuild.
8. Not the most cost effective technology for many applications.

MATCH LASER TECHNOLOGY TO APPLICATION

In general each application needs to be evaluated for determining what the best laser is depending on wavelength, BPP, peak power, pulse length, flexibility, maintainability, initial cost, operating cost, etc. The best laser for a given application may change over time and this fast improving technology must be continually evaluated.