

Grab Your Shades – The **Laser Market** Has a Bright Future

Growing demand for advanced technology in the defense and security, industrial, and medical markets is driving laser industry evolution.

BY JUSTINE MURPHY
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Encouraged by technological advancements, new and innovative applications, and progressively declining manufacturing costs, the global laser technology market is on track to be a \$17 billion industry by 2020, according to the research firm MarketsandMarkets.

Photonics Spectra previously examined the global laser market in January 2012 (“Medical Markets and New Niches Drive Laser Advances”). BCC Research reported that the market hit nearly \$2.4 billion that year. At the time, industry experts were citing the medical market as one to watch.

It remains on the watch list now as one of the top advancing sectors. According to BCC analyst Andrew McWilliams, there exists a positive long-term outlook for the medical market, and its growth is stimulating an influx of potential uses and applications industrywide.

“The market is massive,” according to Charlie Shanks, vice president of sales and marketing at Erchonnia Corp. in McKinney, Texas, in 2012. And the demand for advanced medical lasers and laser systems technology continues to increase with applications including disease diagnosis and treatment, dentistry, and cosmetic procedures, such as those relating to ophthalmology and aesthetics.

A BCC Research report released earlier this year projected that the ongoing evolution of medical laser technology and laser sources (including fiber lasers, LEDs and OLEDs) will keep driving this market’s growth.

In addition to the medical sector, two others are evolving:



‘The future is bright for lasers in both industrial and medical markets ... as lasers continue to improve in cost, performance and cost of ownership.’

Herman Chui, Spectra-Physics



- There is heightened demand for laser systems within the defense and security (namely military) market. Trends in application areas such as airborne laser mine detection are emerging, according to research firm ReportsnReports earlier this year, in addition to “range finding, target designation, anti-missile systems and in neutralizing opponents’ weapon systems.”

- The market for industrial lasers is in a strong growth mode, too, says a 2015

BCC Research market report. Ever-advancing laser technology is prompting this, as older devices are quickly becoming obsolete.

Photonics Spectra (PS) spoke with industry experts for their take on these sectors and their organizations’ roles in the future global laser market.

- Jörg Neukum, director of sales and marketing for Dilas Diodenlaser GmbH in Mainz, Germany, a manufacturer of high-power diode laser components and

systems for defense, medical, materials processing and other applications.

- Marc Tricard, divisional vice president of optics at Zygo Corp. in Middlefield, Conn., a supplier of optical metrology instruments and high-precision optical components.

- Herman Chui, senior director of product marketing at Spectra-Physics (a Newport company) in Santa Clara, Calif., a commercial laser company that specializes in precision laser technologies.

- Matthias Schulze, director of marketing for OEM components and instrumentation at Coherent Inc., based in Santa Clara, Calif.

- Frank Gaebler, director of marketing at Coherent Inc., based in Santa Clara, Calif.

- Kenneth Barat, founder of Laser Safety Solutions in Maricopa, Ariz., and a former laser safety officer at Lawrence Berkeley National Laboratory.

PS: To what can the growth of these markets [defense and security, industrial, medical] be attributed?

Tricard: Recent developments in the fields of High-Energy Lasers (HEL) for defense applications, which have the

Market Briefs, by the numbers

Defense and security

In a report by MarketsandMarkets, the global military laser systems market is expected to grow at a compound annual growth rate of 4.23 percent, reaching \$2.73 billion by 2020.

Industrial

Globally, the industrial laser market should grow at a compound annual growth rate of 10.23 percent through 2019, according to Research and Markets research firm earlier this year.

Medical

By 2019, BCC Research projects that the global market for medical laser devices, which took a hit during the 2008 to 2009 global recession, will reach nearly \$7.8 billion.



potential to dramatically reduce the “cost per shot” versus conventional weapons; High-Power Lasers, built around femtosecond lasers, for high-end physics programs such as the Extreme Light Infrastructure (ELI); medical applications using femtosecond lasers, for a variety of applications such as eye surgery.

Neukum: In defense and security, the growth can be attributed to new applications such as Directional IR Counter Measures (DIRCM), high-energy laser weapons, as well as a change of technology from lamp-pumped range finders and target designators to diode-pumped solutions.

In the industrial sector, laser applications replace traditional material processing techniques due to process advantages, e.g., for plastic welding, laser-based plastic welding process is a clean, contactless, fast and flexible process which even allows online process control. There are a number of good reasons to switch to the laser-based process compared to the traditional ultrasonic welding.

In the medical sector, laser wavelength is often matched to best absorption with the tissue treated. This can result in less bleeding and faster healing. Higher power and faster repetition rates also support shorter treatment time.

In addition, there are a number of aesthetic treatments, such as hair removal, lipolysis, wrinkle removal, etc. These are all treatments which grow when the economies are good.

Chui: The medical market is growing as a result of demographic shifts – aging populations, longer life expectancies, growing middle class in Asia, etc. These trends translate into increasing need for medical diagnoses and treatments. Growth of lasers in the medical market is primarily driven by replacement of non-laser techniques due to improved results. For example, in ophthalmology, lasers have largely displaced blades in refractive surgery due to improved patient outcomes, and lasers are starting to displace blades in cataract surgery, thereby leading to increases in demand for lasers in eye surgery.

The industrial market is growing because of increasing consumer demand for products from a growing middle class in Asia and longer-term improvements in economies. The growth in the industrial market is driven by increasing adoption of lasers in manufacturing applications for three reasons. First, lasers are enabling new manufacturing processes such as micromachining materials or features not previously possible. Second, lasers are replacing

existing non-laser processes by providing a significant benefit, e.g., reduced end-product cost by increasing throughput, eliminating process steps, improving yield or reducing operating costs from consumables/waste, etc. Third, capacity requirements for existing laser-based processes are increasing as overall product demand increases, or the mix of manufacturing processes shift from non-laser to laser. If one looks at the manufacturing of smart phones, one can see all three of these drivers in play – lasers enabling new, finer features not previously possible; lasers replacing mechanical processes; and increasing laser capacity requirements as smart phones demand ramps up.

Gaebler: The industrial market covers an extremely diverse array of applications, from metal cutting, welding, cladding and heat treating in areas such as oil and gas, automotive, and appliance manufacturing, to high-precision microstructuring in machine tool production and microelectronics fabrication. There are numerous market forces at work across all these industries; consequently, some are currently growing and some are not.

Barat: In my mind, the technology advances in diodes and fiber are what have opened up new applications. Just think –100 kW fiber systems are now turnkey, able to run systems on 110 V so 220 or 480 wiring is not required, making the systems more acceptable.

As more systems become turnkey, user knowledge and maintenance requirements decrease, so acceptance increases. It is the old “keep it simple” that is so appealing to product developers and users.

PS: What are the most common applications for lasers and laser systems in each of these markets [defense and security, industrial, medical], and how are they assisting with growth?

Neukum: In defense, the biggest application in terms of quantities is laser range finders, but DIRCM is growing fast. HELs are small in quantity but large in terms of cost per unit. In materials processing, the cutting market is by far the



largest, but marking is still good, and micromaterials processing is growing, especially for ultrafast laser processing. And the medical market has a steady market from treatments with clinical indications, but the growth seems to be in the aesthetic sector.

Schulze: [In the medical market], two of the most important tools used in the development of precision therapies are flow cytometry (for blood analysis) and gene sequencing (for genetic characterization of an individual). Currently, fluorescence is a key technique in how both of these applications operate. And lasers and LEDs are the most commonly used fluorescence excitation source. Cytometers that employ sources having a larger number of wavelengths over a broader spectral region can perform a more extensive analysis of a sample in a shorter time. Currently, cytometers that use 10 or more separate wavelengths are relatively large and expensive tools, and are used almost exclusively in research laboratories. The goal is to bring the size and cost of these instruments down to a level where they can more readily be used in clinical labs, and ultimately perhaps, even in individual physicians’ offices. Sequencing instruments also utilize a number of wavelengths but these are not as standardized as it is in cytometers because there are a number of competing laser-based approaches. As a result, laser solutions in sequencing

vary significantly, and pressure is on the photonics industry to support that variety.

Chui: In the industrial market, the most common application for lasers and laser systems is machining, whether for “macro” or “micro” features, and for metals and many other materials. Lasers are helping the industrial market growth by improving machined part quality and cost, thereby increasing the market opportunity and demand for this industrial manufacturing equipment. In the medical market, ophthalmology (in particular, laser eye surgery) is one of the most common applications for lasers. In this application space, lasers are resulting in improved patient outcomes, thereby driving increasing demand for these procedures. LASIK is an example of how the improved results from lasers resulted in rapid growth in the adoption of refractive surgery. Since its start in the early 1990s, LASIK has grown to approximately 30 million procedures annually worldwide.

Tricard: Our exposure to these applications has been in part because Zygo is uniquely qualified to design and manufacture high-end optical components and/or optical assemblies that many or most of these new laser applications require. Examples include optics made for the National Ignition Facility (NIF) at Lawrence Livermore National Laboratory in Livermore, Calif., or its French equivalent, the Laser Megajoule (LMJ) in Bordeaux, France.

PS: What do you see in the future for each of these markets [defense and security, industrial, medical]?

Schulze: The [medical] market will grow tremendously as OPSSLs (optically pumped semiconductor lasers) enable more sophisticated instrumentation to transition from the research lab into clinical settings. Plus, we see that instrument makers are also striving to improve ease of use in terms of things like sample preparation, so that less operator training is required to utilize their systems, and so that results are more consistent and less operator dependent. All this facilitates the trend toward more widespread use of these technologies.

Barat: Laser weapon acceptance will only grow, as well as the use of spin-off applications and advances having more robust systems in rough environments, many of which no one would have tried using a laser in 15 years ago. Consumer laser systems, like hair and wrinkle removal, can be made safer. Medical sensing will increase and replace blood sugar testing over finger pricks. Internal sensors on a chip will become common place. Laser systems as a replacement in traditional industrial systems will increase, and many new applications will pop up. Just think how 3-D printing has bloomed.

Neukum: In defense and security, the big laser systems are not yet field deployed, but test programs have started, and it will be in the medium time scale that HELs will be deployed. Also, countermeasures are on the rise. The industrial sector will see additional growth by direct diode applications, such as cladding, hardening and additive manufacturing, but also for fiber laser-based cutting applications and in the ultrafast

machining applications. The medical sector is such a wide range with its diverse applications but it offers good opportunities for new wavelengths.

Chui: The future is bright for lasers in both industrial and medical markets. As lasers continue to improve in cost, performance and cost-of-ownership, more and more applications can be enabled by or benefit from laser processes in the industrial and medical industries.

Gaebler: For sheet metal cutting and other heavy industrial applications, continued reductions in laser price, together with improvements in lifetime and reliability, will help the market to continue to expand. It's hard to know in advance what will emerge as the "killer app" in this space, but the capabilities provided by [ultrashort pulse] lasers are certain to play a key role in the development of [the] market.

Tricard: The defense industry has been working on laser systems since the "Star Wars" days 30+ years ago. It is now encouraging to see actual systems getting out of the laboratory and being

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Ken Barat, Laser Safety Solutions



considered for deployment in the field. Similarly, new classes of short-pulse lasers, particularly in the femtosecond regime, are opening exciting new long-term possibilities.

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