Yano Research Institute
April 7, 2008

RESEARCH EXPRESS

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Laser Market in JAPAN 2008

Research Outline

Yano Research Institute has conducted a study on the blue laser market as follows.

1. Research items: CO_2 lasers, LD-pumped YAG lasers, lamp-pumped YAG lasers, fiber lasers, disk lasers, semiconductor lasers, short-wavelength lasers, short-pulse lasers
2. Research targets: Laser oscillator and laser machine manufactures and importers
3. Research period: From October 2007 to December 2007
4. Research methodologies: Primary methodology of face-to-face interviews with relevant personnel of research target companies was employed, supplemented and reinforced by telephone interviews and email follow ups.

Summary of Research Findings

- **Growing shipment of both CO2 lasers and YAG lasers**
  The projected CO2 laser shipment in 2007 is 2,160 units (108.3% year-on-year) owing to the strong demand for the cutting operations for sheet metal work. 2007 projection for YAG lasers is also favorable with 3,367 units (109.5% year-on-year) of shipment backed by the favorable business conditions of semiconductor, FPD (Flat Panel Display) and other electronics related industries that generated demand in such applications as marking, trimming and micromachining.

- **Obvious difference in demand increase depending on laser oscillator type**
  Demand for fiber lasers and for THG YAG lasers that generates the laser of UV range has increased much greater than other types of lasers. The fiber lasers feature its high beam quality, low power consumption, reduced device size, etc. and have increased demand in application areas of marking and micromachining in particular. THG YAG lasers feature its capabilities of machining on hard materials and transparent materials, and of micromachining, and its demand has been continuously strong in the fields of such electronic parts and components as semiconductors, LED, FPD, etc.

- **Users' needs are focused on initial cost, reliability (achievement), maintenance systems and usability of the systems.**
  In order for the lasers to become more popular as processing tools and to further increase its market size, the above listed four factors must be satisfied.

Report format:

Published report: "Laser Market in Japan 2008 - Accelerating Technology Development -"
Issued in: March 2008
Format: 130 pages in A4 format
Price: 300,000 yen (15,000 yen of consumption tax will be additionally charged for sales in Japan.)

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Description of Research

1. Research Background

This report is the forth edition of our comprehensive market reports on the laser market in Japan, started in 2001 with the publication of the first report, "Development and future market prospects of the advanced laser processing machines", and having been regularly published until. The types of lasers covered as target items include CO2 lasers, YAG lasers, LD-pumped high-output YAG lasers, THG YAG lasers, excimer lasers, semiconductor lasers, fiber lasers, disk lasers and femtosecond lasers. Most of these lasers have been studied and developed under the scheme of "Photon measuring and processing technologies" that had been promoted with a five-year-plan for the period between 1997 and 2001. Our initial objective of the research was to know the market size of these lasers developed under this project.

So far, the market size of the lasers has not expanded as much as expected with no particular breakthrough although market growth has been always highly expected, on one hand.

On the other hand, the market has been gradually growing in the long run, repeating fluctuations in every 2 to 3 years, influenced by trends of capital investment of corporations, and the degrees of demand depending on types of lasers.

Table 1: Comparison of sales by oscillator type (Number of units)

Type of Laser Oscillator	FY1999	FY2007 (Projection)
CO2 laser	1,430	2,160
YAG laser (Total)	1,902	3,367
LD-pumped high-output YAG laser	-	48
THG YAG laser	150	628
Semiconductor laser (kW class)	8	51
Semiconductor laser (Smaller than kW class)	6,460	84,930
Fiber laser	160	1,345
Disk laser	-	26
Femtosecond laser	5	63

(Estimated by Yano Research Institute)

In particular, THG YAG lasers and semiconductor lasers (smaller than kW-class) and fiber lasers markets grew drastically. On the other hand, shipment of LD-pumped high-output YAG lasers, semiconductor lasers (kW-class) and femtosecond lasers has not attained the level of shipment volume as expected. Stating differently from the former statement, therefore, the market has been growing at a sluggish pace with no particular breakthrough and has not been expanded as much as expected although it has been exhibiting a trend of gradual growth.

2. CO2 laser machine market

CO2 laser market is expected to mark the record of highest shipment volume for fiscal 2007 supported by active capital investment in recent years. Although the market once peaked in fiscal 2000 with the shipment of 1,630 units, it continuously shrunk down for the following years to 760 units in fiscal 2002, less than the half of the peak, with the impact of IT bubble corruption.

Seemingly, however, the economy bottomed at the time of fiscal 2002 in most segments of industry, and it has recovered gradually and the CO2 laser market has shown continuous growth trends in the fields of heavy industries including steel, shipbuilding, construction, etc. Consequently, the shipment volume is projected to exceed 2,000 units and reach 2,160 units for fiscal 2007.

CO2 lasers are mostly used for the cutting operations and the demand for the two-dimensional machines has lead the expansion of the market. Demand of sheet metal work is strong in various industry fields due to the favorable business conditions, and such industry fields include heavy industry, steel, machine tools, construction machines, industrial machines, metallic materials and heavy electrics.

Those heavy industries listed above are enjoying economic boom in global scale, and this made the demands of cutting operations of aluminum, stainless steel, iron and some others increased. The clients of the cutting operations spread to various countries and areas in the world including Asian countries such as Korea, Taiwan and China, American countries such as U.S.A., Canada, Mexico and Brazil, Middle East and Eastern Europe, and all the manufacturers have increasing export ratio. Demand growth is prominent in BRICs countries that have been achieving notable economic growth.

With respect to the product trends, the most popular category is shifting from 2kW-class to 4kW-class. Although there is still higher demand for the 2kW from some customers mainly in oversea market, needs of high-speed cutting operations with the machines of 4kW or higher has been increasing. The manufacturers have already developed the machines with higher power up to around 6kW, and thus achieved higher power ahead of the real needs in the market.

It is forecasted that the demand of cutting operations steadily and further grow for future. The production facilities are expanding in most industries that generate most demand of the cutting operations, including steel, shipbuilding, machine tools, construction machines and industrial machines, and large demand is expected for various types of machines and components used in these industries. The demand of CO2 lasers are believed to continuously grow for next several years since the markets of infrastructure industries are forecasted to expand, being represented by the boom in construction in BRICs countries and Middle East region and by bio-ethanol production.

3. YAG laser machine market

In the YAG laser machine market, the demand for spot welding of optical and related parts suddenly increased in 2000 due to the rapid growth of optical communications centered on the North American market. Likewise, demand for markers, trimmers, cutting and drilling equipment for micromachining, etc. has largely increased due to the business boom in IT-related industries such as semiconductor, personal computers and mobile phones, contributing to expansion of YAG laser machine market with the largest shipment volume in recent years of more than 3,800 units.

From that time on, demand has started to decline in most industry segments with the corruption of IT and telecom bubble and economy has also started to decline in general, which gave an impact on the demand for YAG laser machine market. To be more specific, the supply of products exceeded the demand and the stock started to increase as a result of too much capital investment backed by the economic boom until fiscal 2000. As a result, capital investment for laser equipment and systems has held down.

Seemingly, however, the shipment of YAG lasers turned upward in around 2003 after it had hit the bottom in 2002. The market has shown growth trends until fiscal 2005 even though the amount of increase in each year is not so large, and there were some fluctuations in demand. This is because domestic economy is recovering as a whole and the demand for laser machines for capital investment is growing in accordance with the economic recovery.

The above situation has lasted into fiscal 2006 and further to 2007, and the market has come back to the level of more than 3,000 units of shipment in 2006 and is expected to reach 3,367 units in 2007.

Currently, business in electronics industry, a major source of demand for YAG lasers, is quite good and various electronic parts and components are required to be further downsized, which have made conventional machine tools obsolete or useless. Therefore, the demands for micro-welding, cutting/ drilling and marking are high in particular and certain volume of shipment is maintained for trimming and repairing used for the areas of liquid crystals and semiconductors.

In addition, demand for the high-power lasers is expanding in the areas of sheet metal work and welding of electric components and of FPD frames. Another remarkable trend includes increased needs for LD-pumped high-output Yb:YAG lasers as a replacement of LD-pumped high-power Nd:YAG lasers that were used in the application areas mentioned herein above.

4. Fiber lasers

Fiber lasers have been attracting highest attention in recent years and its demand has been increasing due to various advantages over other lasers including easier maintenance, laser stability, machine size, etc.

For kW-class, the fiber lasers are expected to replace conventional solid-state lasers and CO2 lasers. For 100 kW-class or thereunder, demand is expected to grow for marking and micromachining.

The demand for marking is growing in view of product control and environmental measures in response to the changes in the regulations such as recycling and PL related laws and regulations. Although the majority of marking machines used to be made with YAG/YVO4 lasers and CO2 lasers, fiber laser machines have outstanding advantages such as higher beam quality which permits superior engraving into metal parts and higher visibility color markings on plastic parts as well as diode-pumping for longer product life and higher energy efficiency compared to the other solid-state or gas lasers. Also, the fiber lasers are free of maintenance, which should be another important factor to raise the demand. These various advantages permit to develop new applications and new users and to expand the market in addition to the replacement of conventional laser machines

5. THG YAG lasers

The THG YAG laser market has been basically achieving steady growth during the period between 2002 and 2007 supported by the favorable business in the industries of electronic parts and components, semiconductors, FPD, etc., major fields of applications of THG lasers.

The components, parts, equipment and devices as applications of laser machining have been always progressing for higher quality, higher precision and higher integration, and accordingly, laser machining for these applications is required to have capabilities to cope with these progresses. Precision of operation depends on wavelength of lasers and the shorter the wavelength is the higher the precision is.

The parts, components and equipment processed by the THG lasers are generally installed in the products with higher added-values such as electronic products and FPD displays, and this should be the major reason why the THG laser market has been expanding in spite of the relatively higher price of the laser systems.

At this moment, there seem no factors that will accelerate market expansion or shrinkage and the THG YAG laser market is exhibiting gradual but steady growth lead by favorable business of the related industries.

6. Request from users

While the laser market has been growing gradually, the degree of the growth has not been as much as it was expected or it could be said that the market stagnates although some sort of breakthrough has been always hoped.

Although there should be many different reasons for the current market status, they could be summarized in four major reasons as follows.

1) High initial cost, 2) Reliability on lasers (Lack of past achievement), 3) Maintenance systems and 4) Usability as systems

As for the item 1) high initial cost, the opinion was made mainly by actual laser users. There are good demands for lasers, however, when the operations cannot be or difficult to be done without lasers or when any sorts of added values could be generated by use of lasers, even if the cost is somewhat higher. On the other hand, many potential users gave up using lasers and have kept using their existing machine tools due to expensive oscillators although they are highly interested to use lasers. While, definitely, there are advantages of lasers in machining operations and in total cost including maintenance cost, high initial cost has remained to be a barrier for introduction of lasers.

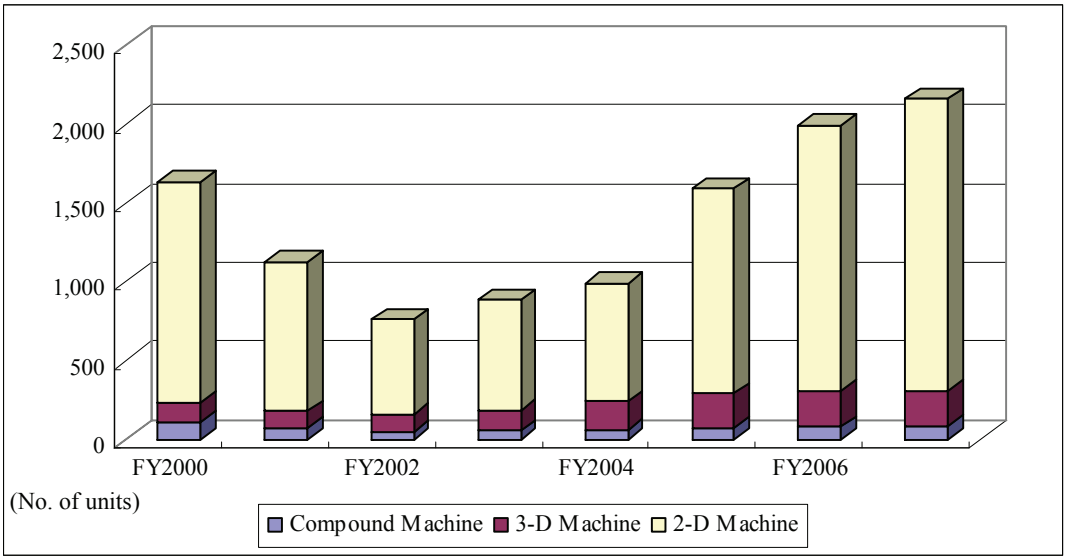
The item 2) reliability (lack of past achievement) does not necessarily mean all laser machines are unreliable since many machines are already operating in the actual production lines. Nevertheless, it is also true that many potential users hesitate to introduce lasers due to instability of lasers and lack of achievement during the long history of production. Anyway, higher stability (reliability) of lasers is required since there are some systems that suddenly stop oscillating or that require maintenance or adjustment too much frequently.

The item 3) maintenance systems should be closely related to the reliability of item 2) which is extremely important since the lasers are, in many cases, used in actual production lines. Even if the laser oscillators are maintenance-free and reliable, highly responsive service and support systems should be required especially when some problems arise in the production lines because the production lines must not be stopped. Users can use lasers without any worries only after such reliable maintenance systems have been established.

The item 4) usability as systems is important in the sense that not all users involved in production are familiar with lasers while some users working for production development, for instance, with enough knowledge about lasers may not have too much concern about usability. At this moment, unfortunately, the laser systems are not necessarily designed to allow production workers not familiar with lasers to immediately cope with any troubles that occur with their laser systems. Therefore, it is always necessary to have laser specialists handle the problems, or to wait for customer support from the manufacturers. This situation could inevitably lead to production downtime and finally to inefficient production and increase in production cost. In addition, there are such negative comments on usability that too much adjustment is required in actual use and too much time is necessary for preparation.

Thus, opinions or views of users on the current laser machines could be summarized in four major factors as described herein above.

Graph 1: CO2 laser processing machine market scale



(Estimated by Yano Research Institute)

Note: The market figures shown include Japanese domestic shipments (including imports) and exports by Japanese manufacturers.

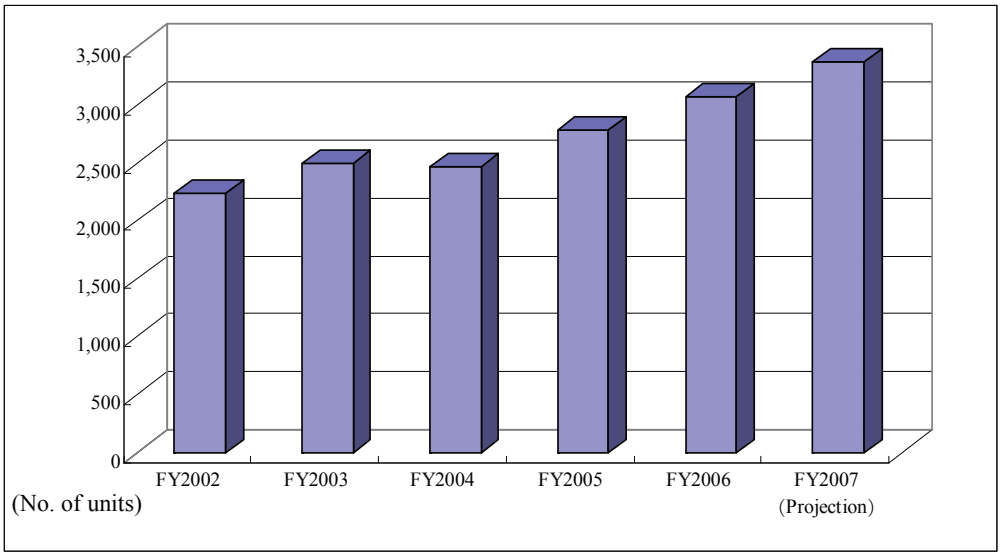
Table 1: CO2 laser processing machine market scale (Number of units)

	FY2000	FY2001	FY2002	FY2003	FY2004	FY2005	FY2006	FY2007 (Projection)
2-D machine	1,400	950	600	700	750	1,300	1,685	1,850
Year/year	116.7%	67.9%	63.2%	116.7%	107.1%	173.3%	129.6%	109.8%
3-D machine	120	110	110	130	180	220	230	225
Year/year	100.0%	91.7%	100.0%	118.2%	138.5%	122.2%	104.5%	97.8%
Compound machine	110	70	50	55	60	70	80	85
Year/year	100.0%	63.6%	71.4%	110.0%	109.1%	116.7%	114.3%	106.3%
Total	1,630	1,130	760	885	990	1,590	1,995	2,160
Year/year	—	69.3%	67.3%	116.4%	111.9%	160.6%	125.5%	108.3%

(Estimated by Yano Research Institute)

Note: The market figures shown include Japanese domestic shipments (including imports) and exports by Japanese manufacturers.

Graph 2: YAG laser market scale



(Estimated by Yano Research Institute)

Note: The market figures shown include Japanese domestic shipments (including imports) and exports by Japanese manufacturers.

Table 2: YAG laser market scale (Number of units)

	FY2002	FY2003	FY2004	FY2005	FY2006	FY2007 (Projection)
Total	2,234	2,495	2,461	2,789	3,074	3,367

(Estimated by Yano Research Institute)

Note: The market figures shown include Japanese domestic shipments (including imports) and exports by Japanese manufacturers.

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