China’s laser market climbs the curve
Will China help global laser sales or conquer them?

Although the laser industry has been on the Chinese government’s hot list since the National Science and Technology Development plan of 1963, it has been the acceptance of free market economic policies of the past two decades that has catapulted Chinese laser businesses, markets, and technology on the world stage.

As China’s meteoric rise to economic super status continues, developed markets around the world gaze look to the Far East and wonder at the impact of adding almost 20 percent to the world’s industrialized population. Will China help global laser sales or conquer them? How will China’s trade policies develop and who will leverage them to their advantage? Is the potential Chinese laser market worth risking intellectual property? According to laser system makers such as Coherent (Beijing), Spectra Physiks, (Beijing), Bookham (Shenzhen), Palomar (Singapore), JDS Uniphase (Beijing, Singapore, Hong Kong and Shenzhen) and others, the answer is definitely ‘yes.’

China lays the groundwork
China’s laser market owes its genesis to several factors, including: significant natural resources, a growing engineering worker class, acceptance in the World Trade Organization and other international trading bodies, and lenient environmental and governmental regulations. As these favorable conditions are bolstered by massive amounts of import revenue, foreign investment and lose intellectual property laws that favor domestic technology transfers – international companies in all industries are asking themselves how will China affect their piece of the global market?

A brief look at the Chinese government’s support of the optoelectronic industry serves to emphasize the countries long-term commitment to use, develop and sell laser technology. Starting in 1986 with the sixth “863” five-year plan, optoelectronics was identified as one of seven key technologies. (In 1949, China launched the first of ten, 5-year plans with the goal of directing the “New China’s” industrial and economic development.) Since adding optoelectronics to the 863 plan, Chinese ministries and scientific organizations have repeatedly confirmed optoelectronics as a growth industry for China. This has prompted 15 provinces to create “optics valleys” in Wuhan city, Guangdong province, Changchun city, Shanghai municipality, Xi’an city, Chongqing city, Zhejiang province, Beijing municipality, Shanghai, Chongqing city, Shandong province, Chendou city, Hefei city, Fuzhou city, Jiangshu province, Jiangxi province and Tianjin municipality [1].

Although development of optical technologies in these regional centers is spread across many disciplines, Zhang Zhi-he of the China University of Geosciences, has identified several regions that focus on laser applications, including: Jilin province, Beijing municipality, Anhui province, Fujian province, and Guangdong province. In 2003, Hubei, Guangdong, Beijing, Jiangsu, and Shanghai sold 85 percent of China’s laser products [4].

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FIGURE 1: Most of China’s domestic laser production is installed domestically. Here a technician at Moulding Industries China (left) is using a lower power laser marking workstation. Higher power laser systems (right) typically use sources from European manufacturers.
China has also opened 11 state-operated optoelectronic laboratories and five National Engineering Research Centers, including Huazhong University of Science and Technology’s (HUST) State Engineering Research Center of Laser Processing. According to the HUST’s Professor Li Zhengjia, the center is focusing on industrial laser machinery; laser cutting systems and technology; laser welding system and technology; laser surface treatment systems and technology; laser labeling systems and technology; key components and technology; and medical laser machinery technology and laser medical equipment.

**China laser market: big picture**

The past 20 years of optoelectronics development and its recent economic boom made China the brightest spot in the global photonics marketplace between 2001 and 2003. This trend continues despite slowdowns in some sectors; China continues to experience double digit growth in laser applications both in domestic sales and international exports. Quantifying China’s laser market outside of the telecommunications industry can be challenging, according to Daniel Lau [2], president of the Hong Kong Optoelectronics Association (HKOEA), because of several factors, including a lack of national standards. In 2003, China’s Ministry of Science and Technology estimated the country’s total optoelectronic exports in 2002 to be Euro 1.44 billion*, while imports were Euro 1.51 billion [3], however, those totals should be considerably higher based on additional sources of information.

In 1987, China’s State committee created the China Optics & Optoelectronics Manufacturers Association (COEMA) to support and guide the development of the photonics industry in China. The group launched one of China’s largest optics conferences – the International Laser, Optoelectronics and Photonics Exhibition (ILOPE) in 1992, and began collecting and disseminating data on the Chinese optoelectronic markets in the mid-1990s based on direct-to-company survey information – a method that HKOEA’s Lau suggests is the most accurate for ascertaining the Chinese laser market. In 2004, COEMA surveyed 137 laser product manufacturers as part of its annual Chinese optoelectronics market report. According to COEMA [4], China’s sales of optoelectronic products, including: telecom equipment; laser processing systems; component sales and holography for security and anti-counterfeiting totaled Euro 2.94 billion in 2002*. That value climbed to Euro 3.65 billion in 2003, and was expected to reach Euro 4.04 billion in 2004, resulting in an annual average rate of growth (AAGR) of 18.3 percent. Out of China’s total optoelectronic sales, laser processing equipment sales rose from Euro 316.5 million in 2002 to Euro 538.9 million in 2003, for an increase of approximately 73.2 percent. A similar report from *Industrial Laser Solutions* (ILS) reported total laser unit sales of 26,505 units during the same time frame in 2003 with worldwide laser systems sales valued at Euro 2.7 billion [5]. Within the overall market, ILS said Asia (including China, Japan and Korea) bought 20 percent, Europe purchased 31 percent and North America acquired 49 percent of those systems based on units installed. In COEMA’s 2004—2005 optoelectronics market report, COEMA puts China’s laser product export sales at Euro 1.8 million, down from Euro 2.1 million in 2002, or a decrease of 14.6 percent – a fraction of China’s total laser sales, which indicates that most systems built in China are installed in China. COEMA lists optical communication, laser processing and parts as the main laser product exports.

In 2003, global revenues from laser sales were split evenly among Asia, Europe and North America, with China’s growth leading the way, Japan staying strong and South Korea retracting [5]. This is partially supported by looking at North American sales figures from the U.S. Association for Manufacturing Technology (McLean, VA). AMT reported that North American laser equipment production accounted for Euro 427 million in 2002, which was down more than 40 percent from 2000 levels do mainly to a global economic slowdown in all regions except China.

**Laser processing: China’s sweet spot**

Although China produces many of the same types of laser sources produced in other countries, a long-standing historical R&D gap with other industrialized nations, slow adoption of optoelectronic standards and a still-growing awareness of quality manufacturing practices has pushed China’s domestic laser production industry towards systems and applications that do not require high power (>150 W), or fine precision controls, such as with lithography or microprocessing. Where China does compete – namely in low power CO2 and solid state lasers where price concerns trump performance – it has dominated the domestic marking,

**FIGURE 2:** Beijing Laser-China Technology Co. Ltd.’s 50-W CLS3500 high speed laser cutting machine is representative of the laser systems widely manufactured, sold and used in China’s domestic manufacturing. The system is sold mainly into the textile industry. Beijing Laser-China Technology Co., Ltd. is located in the Zhongguancun Hi-Tech Zone of Beijing.

**TAB 1:** Laser products sales in provinces and cities in ranking order, 2003 (excluding holography products) [4].

<table>
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<tr>
<th>Ranking Order</th>
<th>Region</th>
<th>Sales Volume (Mio. Euro)</th>
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<tbody>
<tr>
<td>1</td>
<td>Hubei Province</td>
<td>95.0</td>
</tr>
<tr>
<td>2</td>
<td>Guangdong Province*</td>
<td>82.53</td>
</tr>
<tr>
<td>3</td>
<td>Beijing city</td>
<td>42.2</td>
</tr>
<tr>
<td>4</td>
<td>Jiangsu Province</td>
<td>29.37</td>
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<tr>
<td>5</td>
<td>Shanghai city</td>
<td>12.9</td>
</tr>
<tr>
<td>6</td>
<td>Shandong Province</td>
<td>10.9</td>
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<tr>
<td>7</td>
<td>Henan Province</td>
<td>7.4</td>
</tr>
<tr>
<td>8</td>
<td>Zhejiang Province</td>
<td>5.8</td>
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<tr>
<td>9</td>
<td>Liaoning Province</td>
<td>4.3</td>
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<tr>
<td>10</td>
<td>Chongqing city</td>
<td>3.9</td>
</tr>
<tr>
<td>11</td>
<td>Fujian Province</td>
<td>3.4</td>
</tr>
<tr>
<td>12</td>
<td>Tianjin city</td>
<td>3.0</td>
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<tr>
<td>13</td>
<td>Sichuan Province</td>
<td>2.4</td>
</tr>
<tr>
<td>14</td>
<td>Guanxi Self-Controlled Area</td>
<td>1.9</td>
</tr>
<tr>
<td>15</td>
<td>Shanxi Province</td>
<td>1.6</td>
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In just a few short years, China has evolved from country supplying the world with low-cost, mass produced goods to sharing the global laser market with developed countries around the world. The country’s optoelectronics industry development continues to climb from passive optical components, to low-power active systems, and can only continue on to higher performance systems in laser microprocessing, lithography and other laser processing markets.

In a perfect world, deducing future directions for China’s laser industry would be a simple task of evaluating the countries private and public R&D centers; the number of technical presentations in a given technology; the conversion of papers to patents and patents to applications; and finally, normalize the data globally based on China’s available capital investment, existing global trade partners and new market initiatives and weighted by the cultural acceptance of the technology in given markets.

Unfortunately, such a comprehensive analysis is beyond the scope of this article, however, looking strictly at one factor gives some clarity. According to Zhong Ming Lin of China’s Laser Processing and Research Center at Qing Hua University, a study of laser microprocessing, lithography and other laser processing markets.

China: Which way now?

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Fiber laser and thin disk laser research is increasing interest in manufacturing with lasers in all sectors remains strong.

At ICALEO between 2002 and 2004, technical papers from Chinese researchers remained stable, while papers in microprocessing increased eight-fold. This level of R&D interest is certainly indicative of future market development in China, however, commercialization issues remain. A closer look at the institutions involved in Chinese laser R&D shows universities and public institutions as the sole investigators, while the commercial efforts focus strictly on production.

"The Chinese laser materials processing industry needs to develop and increase its research power in order to compete in the world," says Zhong Ming Lin. "The Chinese laser materials processing industry needs to improve its relationships and cooperate with the universities and take advantage fully of the rich research resources of the universities." Although the last four of China's five-year "863" plans have brought significant changes to China's industrial base, it is less clear that the plan by itself will be able to significantly drive R&D development out of the universities and into privately held companies. According to HKOEA’s Daniel Lau, the "863" expert group was effective at setting governmental policy for R&D, but not in driving R&D into the commercial sector. This may change during the 10th and 11th five year plans, scheduled to run through 2010, which are expected to defined by five year plans, scheduled to run through 2010, which are expected to

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<tr>
<td>HeNe Laser</td>
<td>2.7</td>
<td>20.9%</td>
<td>1.4</td>
<td>-50.7%</td>
<td>1.4</td>
<td>7.3%</td>
</tr>
<tr>
<td>CO2 Laser</td>
<td>33.2</td>
<td>110.1%</td>
<td>57.4</td>
<td>72.8%</td>
<td>81.7</td>
<td>42.2%</td>
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<tr>
<td>YAG Laser</td>
<td>68.9</td>
<td>38.5%</td>
<td>94.1</td>
<td>36.4%</td>
<td>102.2</td>
<td>8.6%</td>
</tr>
<tr>
<td>Semiconductor Laser</td>
<td>163.3</td>
<td>132.2%</td>
<td>54.4</td>
<td>-66.7%</td>
<td>81.2</td>
<td>49.3%</td>
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"In particular," Lau says, "China must concentrate on two key areas: intellectual property (IP), legislation and logistics and supply chain [7]. China is working to strengthen IP laws and ensure protection; implementation and enforcement remain a challenge, however. In addition, China is striving to establish a "win-win" situation and build secure, long-term relationships with local Chinese partners in the interest of joint "brand-building." Hong Kong can also play a vital role in helping foreign companies to anchor the IP [intellectual property] aspect of their business. IP issues will remain an impediment and a challenge for all foreign companies until more effective, long-term legislation is introduced in China."

Protecting IP remains one of the biggest hurdles facing laser manufacturers wanting to participate in China's laser market. According to several international trade experts, although regulations protecting IP in China has improved, enforcement is inconsistent, causing hardship both on foreign-based companies doing business in China as well as domestic manufacturers. Although there are not specific numbers on how many patent disputes have been filed with the Chinese government, U.S. Department of Commerce's Asian trade expert, Indrek Grabbi recently told a business development forum held by SPIE (Bellingham, WA) in 2004 that large companies with hundreds of millions of dollars in IP disputes were more likely to get a response from intellectual property (IP) claims, while claims from smaller firms – such as those from small to mid-sized laser companies – are often languished. His advice – choose your partners carefully.

References:
[1] Zhang Zhi-he et al., Opportunities and Challenges During the Development Process of Optics Valleys in China, School of Management, China University of Geosciences, Wuhan Huvei P.R. China, 430074.

* All values are based on exchange rates and currency values for the years stated.