German laser industry:

- Research and industrial policy initiatives, objectives and results: Photonics Congress 2014 in Berlin, export control
- Market trends and potential in laser beam source development and in laser system construction according to triad region
- Business trends in 2013 and outlook

Annual press conference
of the Working Committee “Laser and Laser Systems for Material Processing”
on the occasion of LASYS, the International Trade Fair for Laser Material Processing,
on 24 June 2014 in Stuttgart, Germany,
in the conference room of the VIP lounge used as a press centre
at the Messe Stuttgart exhibition grounds

Your discussion partners are:

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– The spoken word shall hold –
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Update for “Photonics Industry Report 2013”, Photonics Congress 2014 finds wide acceptance

Over more than a year ago, the “Photonics Industry Report” – a publication initiated by the German Federal Ministry of Education and Research and by the German Engineering Association (VDMA), and enriched by other industrial associations of relevance to the sector – documented the sustained success of the industry in general and also of German laser manufacturing technology in particular. The Photonics Congress “Thinking the future – shaping change – success with light”, which was held on 20 February 2014, met with critical praise from political, industrial and scientific circles. In the run-up to that congress, an industry report update was released with the latest figures reconfirming the aforementioned success:

- The growth rates of 3% in both 2012 and 2013 which occurred in the German photonics industries were on a par with those experienced in worldwide gross domestic product and confirm the industries as full participants in the global marketplace. On a euro basis, the worldwide consolidated production value generated by German companies and corporate groups for laser-based material processing systems grew by a full 8% in 2012, and by a further 9% in 2013, while the world market for laser systems increased by just 2%.

- The 8% world market share achieved by German enterprises across the full range of technology held up well in 2012/2013. Beyond photovoltaics and the display sector, that share is however significantly higher in various core segments, with laser systems technology posting a share of 18% or more.

Supported in large measure by the VDMA and its portfolio of seven photonics-related segments, and hosted under the patronage of the German Federal Ministry of Education and Research (BMBF) and the German Federal Ministry for Economic Affairs and Energy (BMWi), the congress has pursued very concrete objectives, specifically:

- Intentionally raising, at an early stage, the awareness of the government team in Berlin – some of whom are still relatively new – of the current importance of photonics and of its role as a technology driver in the future.

- Underscoring the necessity of forming complete value creation chains in Germany – value chains which prevent the foreign outsourcing of new end products and safeguard the priority placed on German manufacturing technology.

- Confidently examining the existing market position for competitive risks – whether already in force today or anticipated in the future – and conveying the notion of “open innovation”, i.e. initiating discussion concerning the degree to which companies with high technological potency should engage in open and growth-oriented strategic partnerships.
Industrial consortium successfully engaged in improving the situation within the framework of export control

The Working Committee “Laser and Laser Systems for Material Processing” has formed an associative consortium comprised of market-leading German manufacturers of lasers and laser systems, in order to stand up for fairer competitive conditions on an international scale relative to export operations in close cooperation with the German Federal Export Office (BAFA). This is a matter of establishing more consistent regulations for the treatment of laser technology in the context of the applicable Wassenaar List of Dual-Use Goods. The aim of one very concretely formulated proposal – oriented towards the treatment of disc lasers, fibre lasers and diode lasers – was to achieve a clear demarcation of non-civil applications. It emphasised the need for an underpinning of a country’s own control-relevant production (and of imports from third countries located in the target markets where the restrictions apply) by a more timely evaluation.

The 2013 Wassenaar closing sessions in the expert group and in the plenary ended with a “minor sensation”: The German proposal, successfully agreed among competitors, passed without objection and was ratified in the high-level meeting. This has brought a considerable sense of relief to German manufacturers in the field of laser macro processing! There is a good chance that accelerated procedures can be used to implement these resolutions into European law. According to current estimates, this would mean that the new regulations can become the basis for export activities by the end of this year.

Motivated by this success, in 2015 the consortium – which is to be strengthened with further expertise – will focus its efforts on a new initiative for the pulse laser sector, which is extremely relevant for “cold” short-pulse techniques in micro material processing. Basic proposals were distributed to the delegation leaders and experts of five national delegations as preliminary information already in April 2014.

User Industries and applications according to dominant and emerging market regions

Asian regions demonstrate the most dynamic overall development and the widest range of applications

The examination of the market-driving regions is divided into three parts: China and Taiwan, the markets of Southeast Asia, and finally the mature national economies of Japan and Korea.

- In recent years, China has developed into Europe’s most important trading partner. The following analysis examines three regions. First China and Taiwan, then the region of Southeast Asia, and finally Japan and Korea.

In recent years, China has developed into Europe’s most important trading partner, and together the two regions represent nearly half of all laser sales worldwide. As one of the market drivers for laser applications in China, the consumer electronics industry must certainly be cited, where laser techniques are used to produce, among other things, smart phones and tablet PCs. So-called EMS (Electronics Manufacturing Services) suppliers produce millions of electronic components, mobile phones and complex electronic system solutions each month. Major EMS suppliers, such as Foxconn, operate factories in China and other Asian countries. As manufacturing
service providers for electronic components, they handle the entire contract manufacturing process – ranging from development and the picking and placement of components on circuit boards to worldwide dispatch. Examples of laser applications in this area include the cutting of films, sapphire glass or other brittle materials, the welding of housings, batteries or plastics, the machining of wafers, the creation of structured surfaces on displays, or the inscription of housings, SIM cards or individual components. And new applications are being added to the list every day.

But other branches such as the automotive industry – which has long been a driving force for innovative laser applications –, the energy sector, or medical technology are also major laser consumer segments. All of these industries use lasers in an extremely wide range of technologies for a vast array of applications. Among them, there are more and more applications involving ultrashort pulse lasers, which are used in medical technology for the “cold” welding of low melting polymers such as nitinol, for example, or in photovoltaics for selective layer removal from solar cells in the nm range. In the textile industry, low power CO₂ lasers are finding increasing use, e.g. in the processing of jean materials.

China has become the “workbench of the world”, so numerous laser applications are not specific to Asia, but rather reflect the high demand for vehicles, medical technology and many other products. The expansion of China’s infrastructure is also in full swing and has accordingly produced a dynamic development of Chinese machinery construction. While local machinery producers create competition for the established machinery producers of Europe or Japan, they also form a growing consumer market for laser sources.

In order to be a successful laser manufacturer in China, it is important to adapt to the culture – and to keep an eye on the competition, of course. More and more local players are appearing on the market – and an increasing number of low cost “Made in China” products are also being offered, especially in the marking segment. China’s future development is likely to remain exciting, also in view of constantly increasing wage costs.

- Closely linked to China, Taiwan makes particularly strong use of lasers in the semiconductor industry. TSMC and ASE, two of the world’s biggest semiconductor manufacturers, are based in this region. But lasers for the already mentioned applications are also finding increasing use in the consumer electronics industry. In addition, Taiwan offers a good OEM basis for micro products and marking products – although this is less true for macro applications.

- Southeast Asia, with countries such as Malaysia, Singapore, the Philippines, Indonesia and Thailand, is particularly attractive for laser applications in the micro and marking sector. In Thailand, lasers are widely used in the jewellery industry. Particularly for fine work on precious metals, the laser is an ideal tool. Lasers can be used not only to set even heat-sensitive precious stones, but also to inscribe the interior, exterior and faces of all types of formed rings.

But Thailand also has companies from the semiconductor sector and a few EMS suppliers and contract manufacturers – mainly for electronic components. Moreover, there is an automotive industry in Thailand which comprises primarily of Japanese manufacturers, although the investment decisions are nevertheless made mainly in Japan.
The region of Southeast Asia, and Malaysia in particular, is a very attractive market for laser applications in the solar energy systems segment and the semiconductor industry.

In Indonesia and Thailand, more and more lasers are also being used for applications in the packaging industry. In that context, CO₂ lasers make it possible to intentionally score specific packaging layers as tearing aids or to add tiny perforations to create a defined atmosphere within the packaging.

- Lasers are also used in the packaging industry in Japan and Korea, whereby those two countries – with brands such as Toyota and Nissan, and Hyundai and Kia – continue to offer a tremendous potential for laser applications in the automotive industry and its supplier segment. Moreover, despite the high rate of growth in China, Japan remains one of the biggest consumer markets for laser radiation sources in the kilowatt range for classic cutting and welding applications. Many renowned machinery suppliers are based in Japan, and they create a strong demand for high-performance radiation sources.

In recent years, Korea has developed into one of the leading economic regions. Along with the automotive industry, Korea boasts two of the world’s leading consumer electronics companies – Samsung and LG – and is also one of the world’s major steel producers. The extremely rapid pace of development in this region has also led to an extensive expansion of the transportation and communications infrastructure. With regard to sales of lasers used for material processing, Korea is one of Asia’s most attractive markets today.

Taken together, Japan and Korea represent a full 20% of worldwide laser sales.

Customers and applications in Germany and Europe

The conditions and trends described below serve as market drivers.

- Bundled expertise in Germany: Germany remains the worldwide hub of operations for suppliers of lasers and laser systems. Accordingly, the applications also cover a wide range.

- Automotive industry as a driving force: In Europe, laser technology is driven above all by the automotive industry, which uses nearly every laser-based application (cutting, welding, drilling / ablation / structuring, overlay welding, soldering, marking, etc.). Along with the OEMs, suppliers also make use of various levels of laser technology.

- Resource efficiency: Strong trends currently include resource-efficient production and resource-efficient products. Europe’s relatively high environmental consciousness lends particular importance to the efficiency of the products.

- Lightweight construction: As a consequence, the automotive industry is turning its attention to lightweight construction again. Innovative steel alloys, aluminium, fibre-reinforced plastics and material blends are being used to reduce the weight of vehicles while providing greater crash safety. In some cases these materials and material combinations cannot be processed without lasers, e.g. in the cutting of hot formed steels, the joining of aluminium and steel, the joining of plastic and metal, or the machining of CFRP and GRP.
• **Drilling with USP lasers**: Bosch has achieved a hugely innovative breakthrough in the manufacture of its fuel injectors. The use of ultrashort laser pulses makes it possible to optimise the nozzle holes. This improves injection and combustion – and ultimately results in a significant increase in the efficiency of injection engines.

• **E-mobility**: Laser technology is also having an impact on the growth of electromobility. Laser processes are becoming more and more prevalent here, especially in the production of battery cells.

• **Additive manufacturing**: Additive manufacturing processes such as LMD and SLM continue to offer huge potential, both within and beyond the automotive industry. Along with the potential for material savings and low energy consumption, additive processes provide previously unmatched customisation capabilities from small-scale series production runs down to individual pieces. Many of these applications are currently still under study in university laboratories and will eventually become ready for industrial use over the course of the next few years.

• **Machinery for the semiconductor industry**: In the semiconductor industry in Asia and the USA, much of the machinery and equipment based on laser technology originates from Europe. This includes, among other things, equipment used to cut displays, machinery to cut and drill circuit boards, laser marking systems, and not least, complex chip manufacturing machinery. In this context, the next generation of chip manufacturing technologies – EUV lithography, which is based on CO2 laser systems – is now ready and waiting in the starting blocks. So the sustained boom in hand-held devices is also having a positive impact on European machinery construction and laser technology.

• **Cutting with solid-state lasers**: Smaller suppliers and job shops now make standard use of laser technology too – especially for cutting and welding. Due to their flexibility and efficiency, solid-state lasers such as disc lasers are used more and more frequently for 2D cutting.

• **Laser technology in photovoltaics**: Europe in general – and Germany in particular – are bastions for renewable energy technology. Although Germany and Europe are experiencing increasingly intense competition in the photovoltaics sector, this industry remains a comprehensive innovation driver for numerous laser processes and is expected to generate higher incoming order volumes again in the future. Dr. Ralf Preu, division director of Photovoltaics Production Technology and Quality Assurance at the Fraunhofer ISE Institute for Solar Energy Systems, was awarded the first prize of “Innovation Award Laser Technology 2014” for the Laser Fired Contact (LFC) technology for the production of high-efficiency silicon solar cells.

The following is a list of current trends in major individual markets:

- **Germany** itself offers a solid market, which continues to be distinguished by exports.
- Automotive construction and its supplier industries in **Great Britain** have risen “like a phoenix from the ashes”.
- Activity in **Italy** remains lacklustre with only modest signs of recovery, but many machine tool manufacturers there serve as laser technology integrators.
- **France** is not providing any source of stimulus; its automotive industry is outsourcing production abroad – and also especially to Eastern Europe.
• Despite high unemployment, **Spain** retains its relevance as a manufacturing location for the automotive sector – so the pace of new laser manufacturing technology installations continues to be high there.

• **Turkey** represents a major market for truck and bus production equipment along with the associated supplier segment, both of which offer considerable application potential for laser technology.

• With regard to laser applications – unlike the machine tool industry in general – **Scandinavia** exhibits stable development.

• **Eastern Europe** continues to reap the benefits of production outsourcing, whereby the conflict in the Ukraine and turbulent relations between Russia and the EU obviously represent a risk.

**Application fields and solutions in the USA, general market development and trends specifically related to diode lasers**

Development is being affected primarily by the application trends described below.

• **Resurgence of the automotive industry**: The USA is following the European trend in laser applications in the chassis construction segment (remote welding, hard soldering, aluminium welding, and cutting). For structural reasons, Tier 1 suppliers are also making increasing use of laser technology. Automotive production has almost returned to record levels and forecasts remain good.

• **Oil and gas industry**: The USA has traditionally been very strong in the field of gas and oil production equipment technology. The use of laser metal deposition welding to repair that equipment is becoming more and more widespread and has established itself as standard practice. NAFTA (USA, Canada and Mexico) is the biggest and fastest growing sub-market in this sector.

• **Additive manufacturing or 3D printing**: As in Europe, potential users are also showing very keen interest in this technology in the USA at the moment. While previous attention focused mainly on the use of Selective Laser Melting (SLM) to produce prototypes and samples, current efforts are increasingly aimed at developing additive laser techniques for future small-scale production, especially from metallic materials. The advantages of this manufacturing method have been recognised not only by the aerospace industry, but also by the automotive segment and other manufacturing sectors.

• **Cutting with solid-state lasers**: In the USA, there is an increasing trend towards replacing CO₂ lasers with fibre lasers (and in some cases with disc lasers) in several applications.

The overall trend in the USA is characterised by:

• Strong market growth until at least 2016, especially as a result of backlog demand in automotive construction.

• US laser manufacturers are marketing more and more products in the 1-kW range.
There is clear tendency to transfer production previously outsourced to Asia back to the USA.

Development trends and applications affecting the diode laser segment:

- Complete diode lasers for direct use are an established technology. Demand here is growing faster than in the rest of the laser market, but still represents only a small share of the total worldwide market.
- New participants are entering the market, both in Europe and in Asia.
- Direct diode lasers are competing with fibre lasers and disc lasers in the welding segment to an ever-increasing extent.
- In the hardening, deposition welding and hard soldering area, diode lasers are the standard radiation source. For this reason, many of these applications can be found in the automotive sector, the oil and gas industry, and tool and die making.
- The trend towards hybrid technologies continues unabated. Diode lasers are increasingly being integrated into other manufacturing processes as “laser-assisted machining”.
- The use of new materials such as aluminium, magnesium and carbon-fibre-reinforced polymers (CFRP). The resulting new applications can be carried out with diode lasers.

Worldwide consolidated production results count in the laser systems output, fresh shifts in export shares among the members of the triad

- In 2013, the German suppliers represented on the Working Committee produced laser-assisted manufacturing systems worth approximately EUR 767 million at locations within Germany, which represents an 8% increase versus the reference year 2012 (+2%). The worldwide consolidated balance, i.e. the production result after accounting for the added value created by corporate groups with international operations, posted sales of about EUR 913 million and a 9% increase as compared with the previous year (2012: +8%). This means that the “internationalisation premium” relative to the production value generated in Germany amounted to a full 19%! Both the output in Germany and the production result after worldwide consolidation underscore the significantly greater momentum in systems equipped with solid-state lasers. CO2 systems edge ahead in the worldwide analysis, however, exhibiting more stable volume growth than within the headquarters country of Germany.

- The incoming order volume achieved in 2012 (-2%) expanded by about 4% to around EUR 871 million in 2013. That overall result captures widely differing shares of orders from within Germany and abroad: Following weak growth in the reference year domestic demand fell by nearly 13% while demand from abroad, which had increased by 5% in 2012, grew by an additional 9%.

- In 2013, laser system exports from Germany posted a strong 20% increase and a volume of slightly more than EUR 570 million. The share of production value rose from 68% in the reference year to more than 74%. Relative to the structure in 2012,
the destinations China and Central / Eastern Europe declined substantially. Regions posting growth in their relative share of German imports included Western Europe, the category “Other Asia” (excluding directly allocated shares of Japan and China, and therefore applicable to India, Korea, Taiwan and the countries of Southeast Asia), and Japan itself. The USA participated at the same level as in the reference year.

Statistics on laser beam sources broken down according to new criteria

- Reporting year 2013 witnesses the restructuring of the association’s statistics on beam sources. Complete diode lasers for direct use are hereby integrated within the volumes posted for three types of radiation sources, specifically: CO₂ aggregates, solid-state lasers and diode direct lasers. Rates of change cannot be determined again until the survey for 2014 has been compiled. At present, only the supplementary posting of interim results for the first half of 2013 can be used to identify the trend over the course of the year.

- In this context, in 2013 the trend in the radiation source segment (without feed machinery) exhibits a rather strong discrepancy between the rates of growth in production volume and incoming orders. The production value of EUR 522 million generated in Germany corresponds to orders valued at EUR 442 million, which means that the value of the orders lags about 15% behind the output actually achieved. During the course of 2013, a glance at the structure at mid-year reveals essentially equivalent shares for the two periods in terms of their contribution to the total volume. The consolidated worldwide production, after inclusion of the value added within the corporate groups as already listed, totals EUR 696 million. This result is about one third greater than that of Germany as a manufacturing location, and therefore represents a much more meaningful performance level. In addition, the members of the association posted a total of around EUR 244 million in laser diode production values in 2013. That figure reflects diode stacks, pump modules, and – also included for the first time – diode materials produced in-house and incorporated exclusively in the manufacturer’s own solid-state lasers, along with excimer lasers. The latter product group succeeds in the area of microstructure production, and in applications related to laboratory and medical technology.

- Unlike the situation for the laser systems area, the shares of domestic and foreign orders posted within total incoming orders demonstrate near parity in terms of value, with EUR 219 million and EUR 223 million, respectively. Within Germany, the value posted for the first half of the year was slightly below the second half year; in the export business, the value posted for the first half was about 6% above the value of the second half year.

- The figure for the export volume of CO₂ lasers, solid-state lasers and diode lasers for direct use was EUR 295 million. The volume during the first half of the year was nearly 3% higher than the second half year. Due to the expanded range of statistically recorded radiation sources as explained above, it is impossible to determine the relative rates of change among the destination countries. In terms of geo-economic export shares, however, it seems nonetheless plausible that, in the case of Asia, the value posted for the first half year was 6% above the total result for 2013 – unlike in the USA and Western Europe, where the figures for 2013 were 4 and 3 percentage points above the corresponding shares for the first half year.
Medium-term outlook remains favourable, new business models and development of local processes are determining factors

- According to the latest press release from Optech Consulting of Tägerwilen, Switzerland, the world market for laser systems reached a new record volume of about EUR 8 billion. The market for laser systems used for material processing – especially for cutting, welding and labelling – increased to more than EUR 6 billion, thereby demonstrating a rate of growth which was significantly greater than that of worldwide machine tool consumption. The market for laser systems used for micro processing – i.e. oriented towards applications for the production of semiconductors, solar cells, circuit boards and flat screens – followed, versus the previous year, the same trend as the declining equipment market for semiconductor production. The main cause of the sluggish development of the overall market for laser material processing systems in 2013 as compared to medium-term annual growth rates was the declining demand in Asia during the second half year. Led by strong individual markets such as Germany and Italy, however, Europe – which consumes about 30% of the laser systems – provided for an expanded demand of about 10%. That result marks a change in direction as compared with 2012, when Europe was only able to maintain zero growth on a euro basis and came in last place worldwide. America, too, demonstrated market expansion with its demand share of 15% in 2013.

- A glance over prognoses for worldwide machine tool consumption indicates – following dampening effects in 2014 (4% growth) – a medium-turn return to substantially higher growth rates on the order of 8% to 9% in the period from 2015 to 2017.

- The continued high investment potential of the German laser industry, a research policy focused on particularly promising technology fields, and Germany’s nationwide and particularly effective scientific infrastructure should help to sustain a strong presence in the global marketplace. In some cases, demand has shifted dramatically towards the Asia-Pacific region. This presents challenges for small and medium-sized companies in terms of sales and service, the use of local procurement markets, and increasing demands for local value creation. Companies within the industry are addressing those challenges more and more intensely.

Stuttgart, 24 June 2014

The full text and accompanying diagrams on the business development of the industry in 2013 can also be downloaded from the internet: see laser.vdma.org, here under “News”, “Economic Information” and “Press Releases” – news. Pictorial material can be obtained either from the association’s office or also, of course, directly from the companies of the speakers.