

Munich, March 27, 2023

Press Release

The dawn of the era of integrated photonics

- **Integrated photonics systems open the door to new applications**
- **Important players at LASER World of PHOTONICS 2023**
- **Huge potential for energy-efficient data traffic**

Whether it's data communication, aerospace sensors or autonomous vehicles, whether it's biophotonics or medicine: Integrated photonics is pushing the boundaries of what is technically possible and is a promising application for stemming the rapidly growing energy demand of data traffic around the world. Important players in this up-and-coming technology will come together at the World of Photonics Congress from June 25 to 30, 2023 and at the leading international trade fair for photonics components, systems and applications – LASER World of PHOTONICS – from June 27 in Munich.

In natural sciences there may be no miracles, but the EUV (Extreme Ultra Violet) exposure process, for which a team from LASER exhibitors – TRUMPF, ZEISS and Fraunhofer IOF – received the German Future Prize 2020, certainly comes close. In their process, in order to provide state-of-the-art semiconductor chips with structures in the single-digit nanometer range (nm), 50,000 tin drops per second are bombarded with two pulses each from a high-performance CO₂ laser. The tin plasma ignited in this way emits the extremely short-wave (13.5 nm) EUV radiation that is required for the chip exposure. The process is based on precision optics that can direct the laser beam with such precision that it would be able to hit a golf ball on the moon.

Thanks to this combination of laser technology and high-end optics, chip technology is advancing on a scale that is beyond imagination. A few years ago, it was possible to fit 10 billion transistors on the surface of a fingernail;

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this number is now approaching the trillion mark. This is the implementation of Moore's law, according to which the number of transistors in integrated circuits doubles every 18 months. Since nano-scale production is reaching the limits of what is technically feasible, "More than Moore" concepts are required. It's still about chip designs that advance into the third dimension via the 2.5-D intermediate step. But in the long run even 3D chips will not be enough to cope with the rapidly increasing data volume worldwide.

Integrated photonics can push boundaries

One solution: Integrating photonics directly into chips, sensors and other technical components in the form of photonic integrated circuits (PICs) instead of using photonic processes to manufacture electronic chips. A promising and cost-effective solution is to fabricate such optical circuits on traditional silicon wafers. That's because the existing production infrastructure of the semiconductor industry would only have to be supplemented selectively in order to introduce the light-based circuits into the optically "difficult" silicon using established pulse etching processes. In principle, this means entire photonic systems with laser beam sources, light guides, couplers, filters, signal modulators, ring resonators and photodetectors can be integrated into the chips. Since this world of manufacturing also moves on a nano scale, maximum precision is required. Achieving this requires iterative, interlocking design, validation and manufacturing processes. Hundreds of process steps are needed to achieve nanometer-precise alignment and to exploit the finest thermal correction options. The enablers of the optical circuits come from the LASER community: nano-positioning technology, ultra-precise testing and measurement methods, and also III-V semiconductors, which selectively compensate for the photonic deficit of the silicon.

Leading providers of simulation and design tools such as [Synopsys](#) and [Cornerstone](#), of manufacturing solutions ([FiconTEC](#), [finetech](#), [LIGENTEC](#)) as well as providers of testing and measurement solutions, positioning technology and semiconductors will present their innovations at LASER World of PHOTONICS. In Hall A2, there will be a focus area for Integrated Photonics

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as well as application-oriented presentations. The World of Photonics Congress, which will bring together thousands of international experts in Munich, will also thoroughly address integrated (silicon) photonics. The potential of this technology is enormous.

Huge potential

Replacing electricity with light in PICs gets rid of disadvantages such as the strong heat generation, the conversion of optically remotely transmitted data into electrical signals and vice versa, as well as the spatial requirements of electronic-optical assemblies. And because the data is transmitted and processed in miniaturized PICs on numerous wavelengths in multiple modes, at higher speed, low thermal effects and optimal integration capability combine to create a viable prospect to be exponentially enhanced to handle growing global data volumes much more efficiently than before. Within a decade, integrated photonics has matured into a key technology for data centers. What began with optical data transmission in global fiber optic networks has advanced in the form of optical transceivers in server farms, then provided chip-to-chip connections, and is now advancing to individual microchips. Thanks to the comparatively low heat generation, the young technology will also reduce the energy requirements of data centers, which cause around two percent of global CO₂ emissions. Driven by this application, global sales of silicon photonics are expected to increase to USD 972 billion by 2027, according to forecasts by Yole Intelligence – which would correspond to a 6.5-fold increase compared to 2021. However, the market potential of integrated photonics is far from exhausted.

Applied to miniaturized LIDAR sensors, the technology is moving toward autonomous vehicles. Research laboratories are using micrometer-fine needles with integrated photonic circuits to stimulate fluorescence effects in living tissue in a very targeted manner. And there are projects all over the world to use PICs to develop smart implants, miniaturized diagnostic and analysis devices or sensors in miniature format for aerospace, agriculture,

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the food industry and many other fields of application. In short: Integrated photonics has the potential to usher in a new era technology.

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LASER World of PHOTONICS and World of QUANTUM will be held at the Munich exhibition grounds from June 27 to 30, 2023, at the same time as automatica, the leading exhibition for automation and robotics. You can visit all three events with just one ticket.

About the LASER World of PHOTONICS

The LASER World of PHOTONICS is the world's leading platform for the laser and photonics industry. Europe's largest World of Photonics Congress is part of the trade fair. The program comprises a number of scientific conferences held by globally leading organizations. In addition, Messe München offers practical presentations on photonics applications ("Application panels"). The LASER World of PHOTONICS has been held every two years since 1973; the next edition will be held from June 27 to 30, 2023, in Munich, the next World of Photonics Congress parallelly from June 25 to 30, 2023 at the ICM - Internationales Congress Center München.

world-of-photonics.com/en

About the global network of LASER World of PHOTONICS

The LASER World of PHOTONICS has established an international network. The LASER World of PHOTONICS CHINA and the LASER World of PHOTONICS INDIA are regional leading trade fairs for lasers and optical technologies, and are organized annually in China (Shanghai) and India (switching between Bengaluru, Mumbai and New Delhi) respectively. With the trade fairs in Munich, China and India, Messe München is the world's leading trade fair organizer for lasers and photonics.

About Messe München

Messe München is one of the leading exhibition organizers worldwide with more than 50 of its own trade shows for capital goods, consumer goods and new technologies. Every year, a total of over 50,000 exhibitors and around three million visitors take part in more than 200 events at the exhibition center in Munich, at the ICM – Internationales Congress Center München, the Conference Center Nord and the MOC Veranstaltungszentrum München as well as abroad. Together with its subsidiary companies, Messe München organizes trade shows in China, India, Brazil, South Africa and Turkey. With a network of associated companies in Europe, Asia, Africa and South America as well as around 70 representations abroad for over 100 countries, Messe München has a global presence.