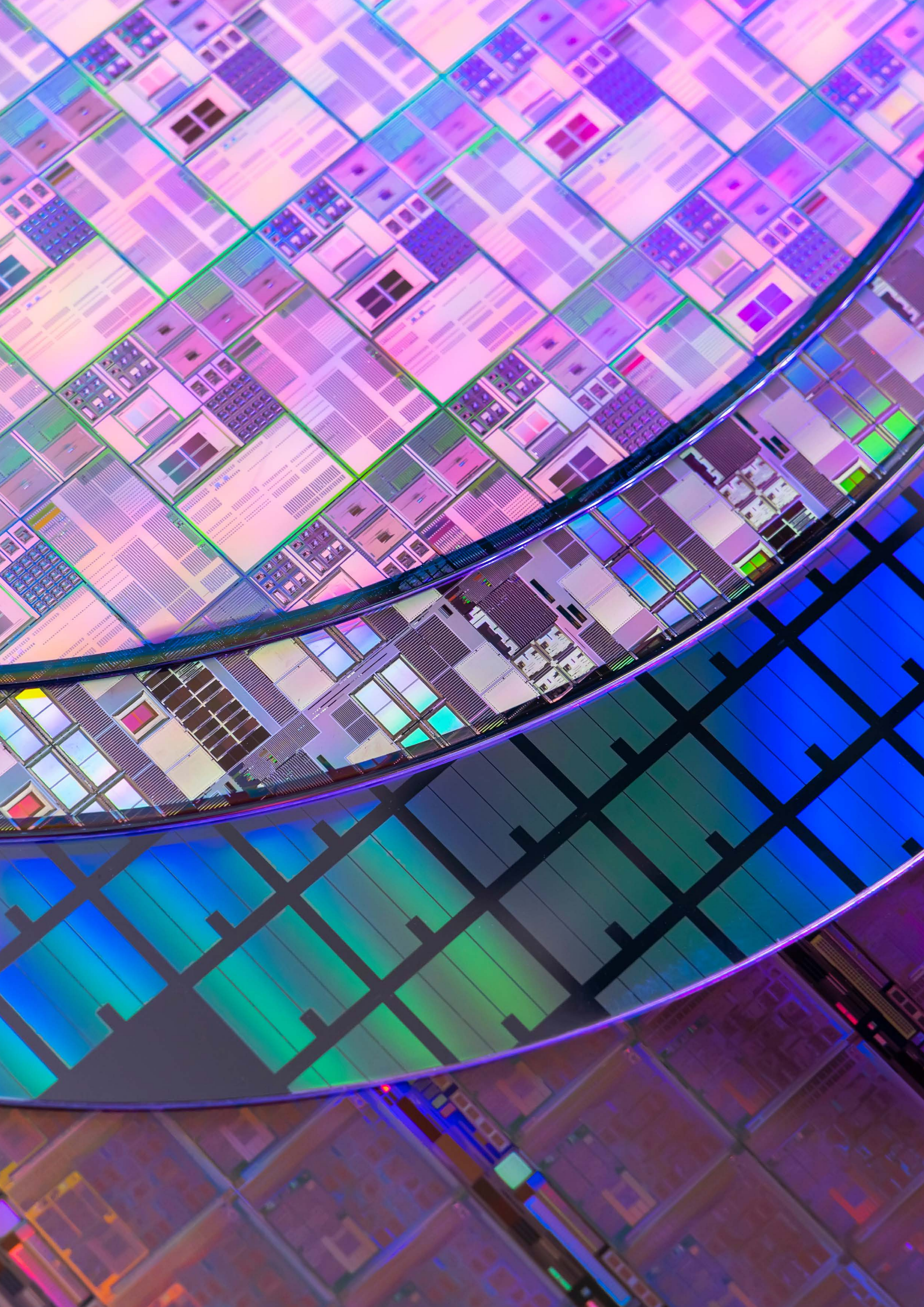


A high-magnification, top-down view of a semiconductor die. The die is a square chip with a complex, grid-like pattern of circuitry. The colors are vibrant and varied, including shades of purple, blue, green, yellow, and red, which likely represent different materials or layers of the chip. The pattern is highly regular and repetitive, characteristic of a microprocessor or similar integrated circuit. The die is set against a dark background, and the overall image has a futuristic, technological feel.

Semiconductor and Photonics



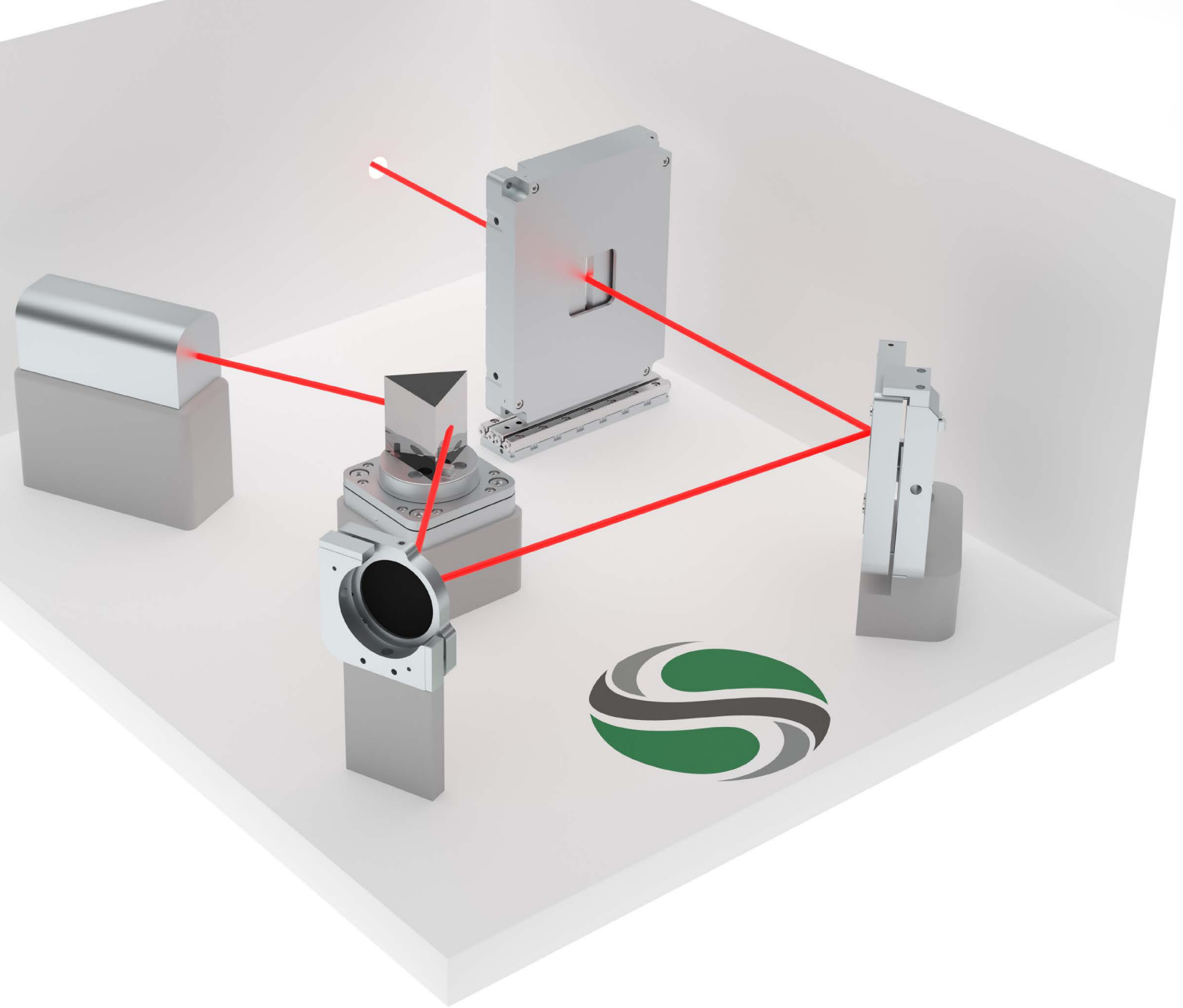
Semiconductor and Photonics

The markets of semiconductors and photonics continuously require groundbreaking innovations to meet the ever-evolving needs of mankind in telecommunication, information processing, medicine and industrial manufacturing. We at SmarAct Motion contribute to these innovations with high-precision positioning technologies providing the outmost accuracy and stability at an unmatched compact size.

With an in-house production ensuring both highest quality and upmost flexibility, we address the requirements

of OEM solutions as well as customized simple and complex positioning systems. Our products are compatible even with extreme environments like cryogenic temperatures, ultra-high vacuum, or magnetic fields.

Whether you need a single positioner for an experimental setup for quantum computing, an OEM positioner in your laser, or an integrated motion system for your semiconductor manufacturing equipment, we are prepared to develop and fabricate the right solution for your specific application.



OEM Laser Components

Laser technology is essential in nearly all innovations in semiconductor and photonics industries. From wafer inspection and doping to lithography and optical communication, lasers play a vital role in the manufacturing of advanced electronic devices, optical systems, and communication networks.

Our laser components are designed to meet the stringent requirements of these industries. We offer a wide range of products,

including linear and rotation stages, motorized mirror mounts, iris diaphragms, and rectangular apertures designed to provide efficient and reliable positioning in your laser setup at a resolution down to 1nm at an unmatched compact footprint.

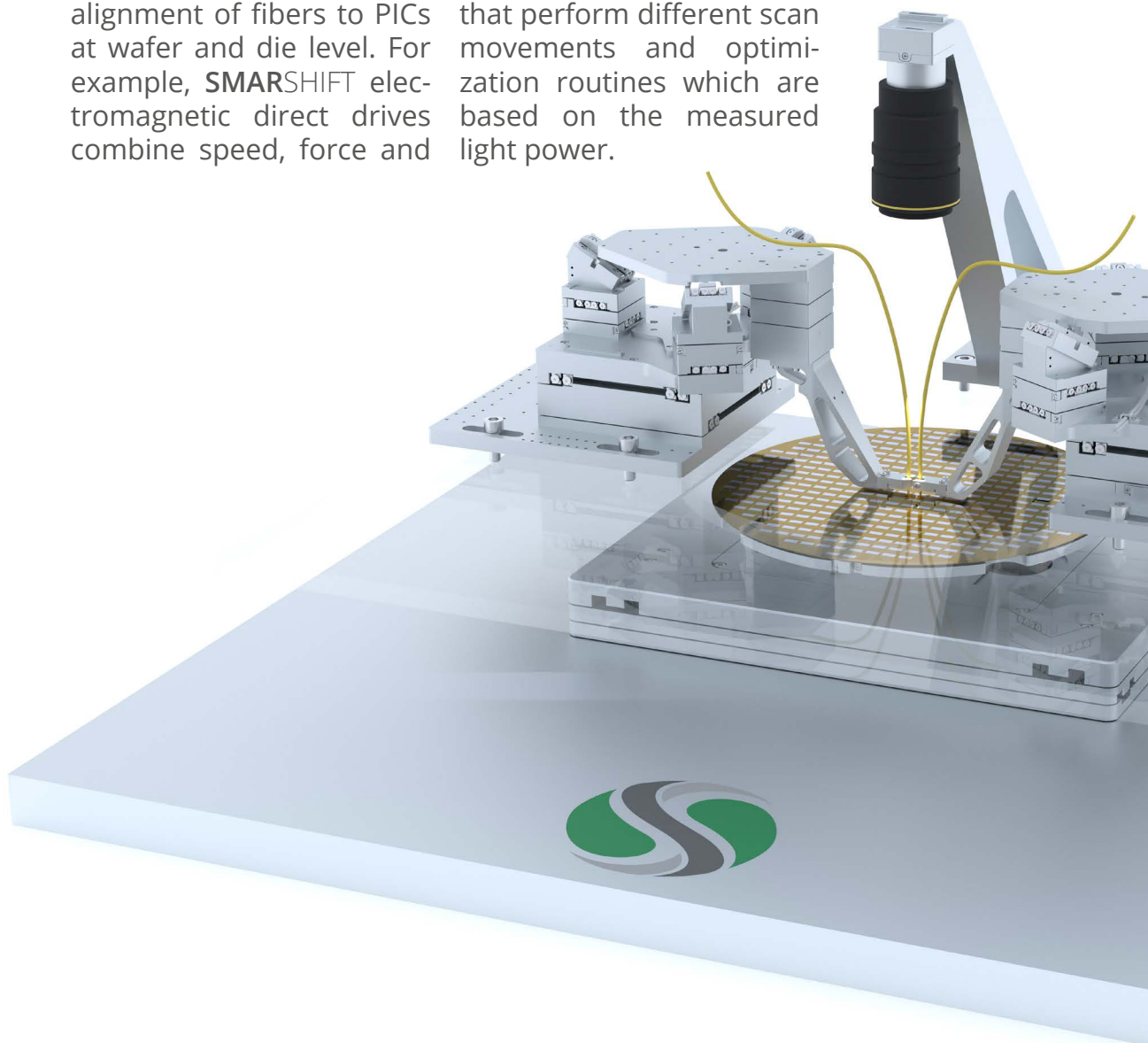
Enhanced levels of cleanliness of the products, often needed in lasers, are fulfilled by special treatment and handling in our production.

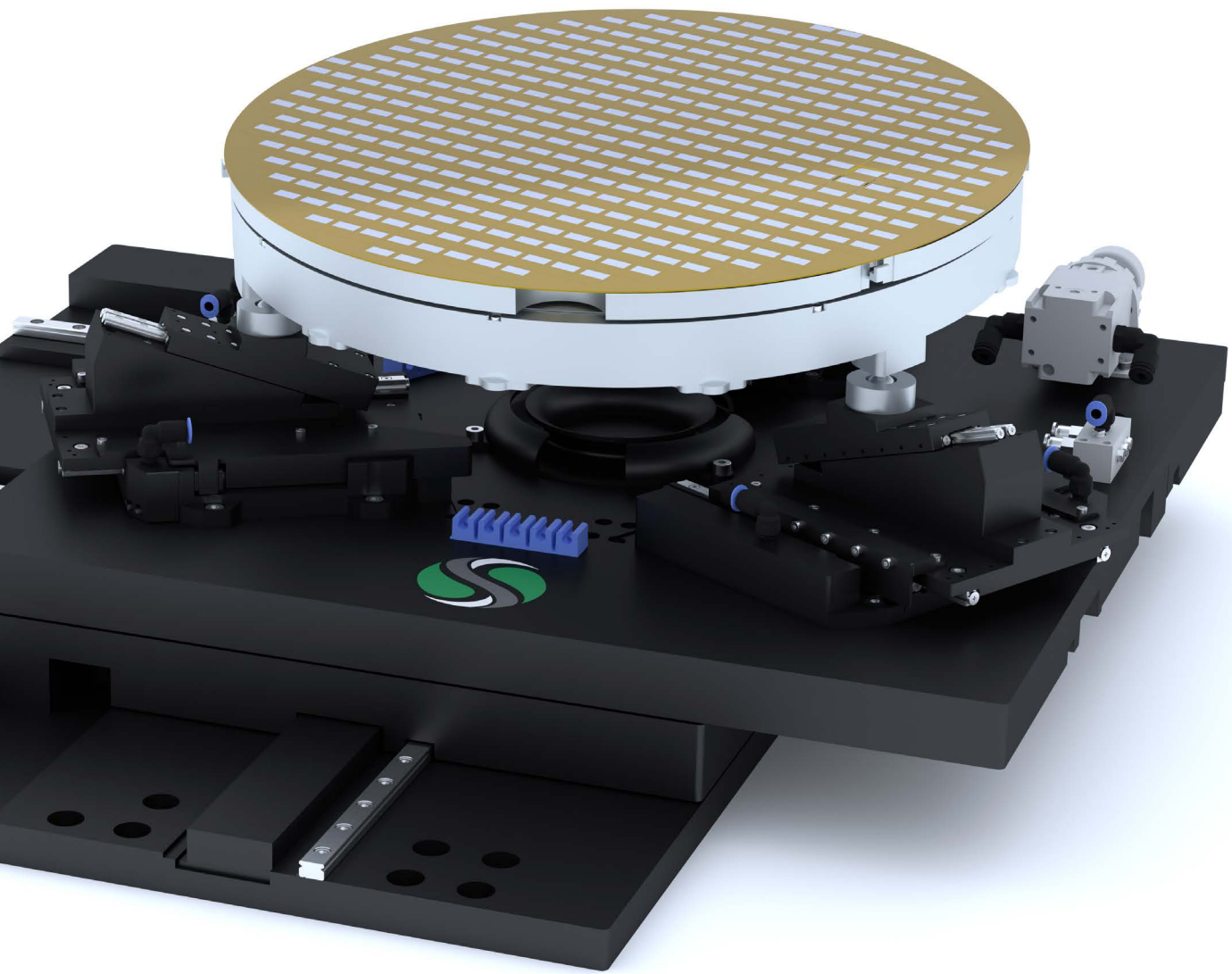
Fiber Alignment for Photonic Integrated Circuits

Photonic Integrated Circuits (PICs) have great potential to drive the steady performance increase in information processing. PICs have advantages when it comes to higher density, higher speed, and improved power efficiency. Especially silicon photonics allows for a high level of integration by fabricating PICs with conventional semiconductor manufacturing techniques. The combination of different SmarAct Motion technologies is the key for a versatile system that enables fast and accurate alignment of fibers to PICs at wafer and die level. For example, **SMARSHIFT** electromagnetic direct drives combine speed, force and

nm accuracy and can move wafers in up to six degrees of freedom. **SMARPODS** bring fibers in position via coarse alignment to couple light into and out of the wafer. Additional XY motion in a square of 60mm x 60mm is provided by **SMARSLIDE** stages.

The actual fine-alignment is performed by a **SMARFLEX** XYZ piezo scanner stack, ideally combining the requirements of nm resolution and high speed. To minimize the coupling speed, the **MCS2** controller includes algorithms that perform different scan movements and optimization routines which are based on the measured light power.

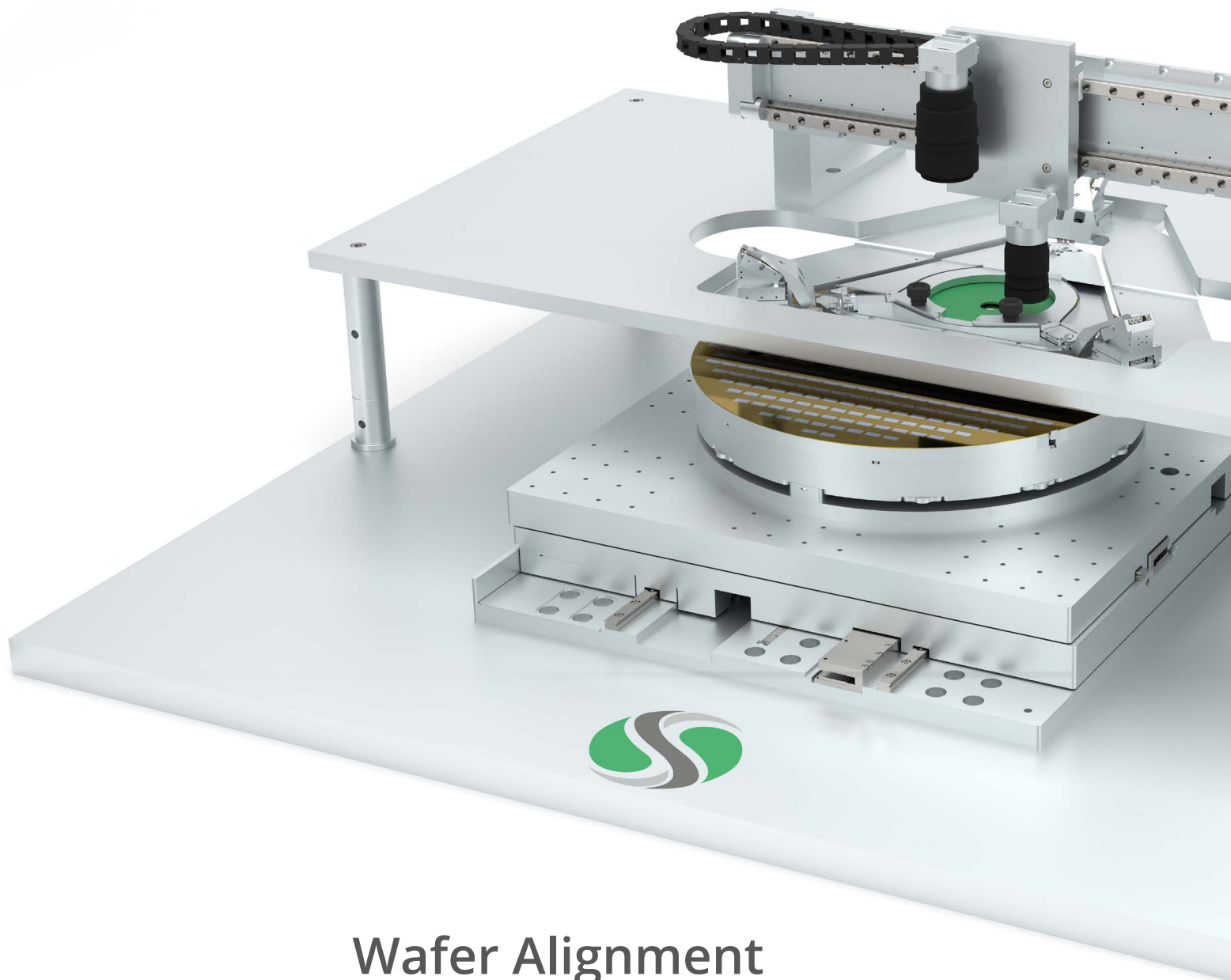




Wafer Positioning

Wafer positioning is an essential step in the manufacturing of semiconductors and photonics, allowing for accurate placement of components such as integrated circuits and PICs. Precise alignment leads to improved device performance and functionality, resulting in high-quality products for customers. The electromagnetic **TRIPOD** is a solution that offers high-precision positioning and alignment of wafers in six degrees of freedom with maximum accuracy and flexibility. The

system is designed to handle heavy loads up to 6kg at high velocities (translational: 200mm/s; rotational: 15°/s), allowing for dynamic and versatile performance. In addition, **SMARSHIFT** electromagnetic direct drive stages are durable and virtually maintenance-free. Overall, they enable the precise positioning and alignment of wafers during fabrication steps, ensuring high-quality and reliable semiconductor devices.

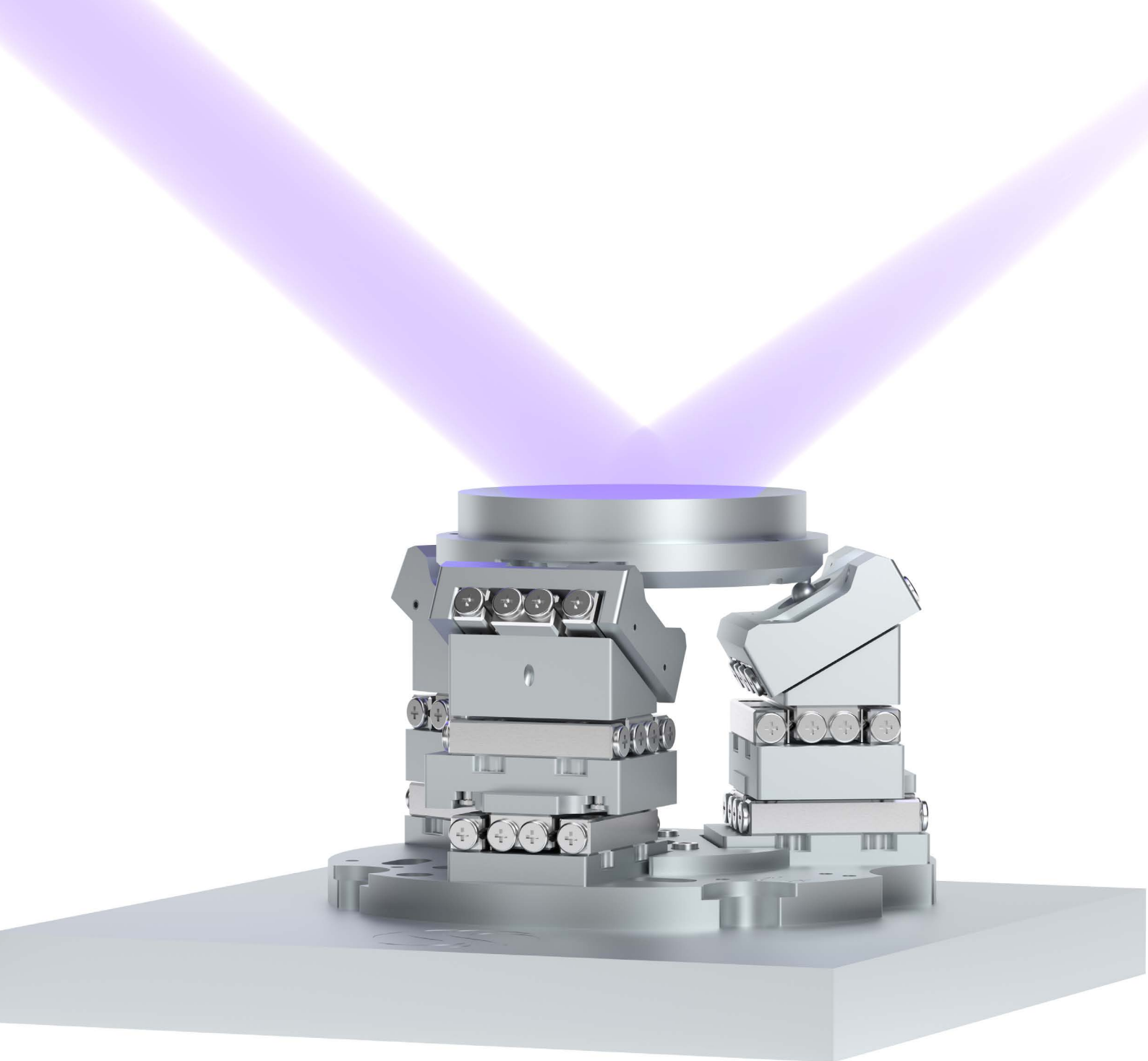


Wafer Alignment

Many steps in semiconductor development and manufacturing require high-precision alignment of a processing or testing device with respect to wafer. This can be a mask in a photolithography process, a substrate with micro LED arrays for micro display assembly, or a probe card for wafer testing.

SmarAct offers different motion and metrology systems that are optimized for the individual alignment task. The example shows a system with a 300mm wafer

which is moved in XYR by **SMARSHIFT** electromagnetic direct drive stages while a **TRIPOD** aligns a probe card vertically with respect to the slope of the wafer. The approach is supported by three tactile sensors inside the **TRIPOD**, which are used for closed-loop force control. In addition, the design of the **TRIPOD** is ultra-flat such that microscopes with different working distances can be moved over the point of interest with the help of a **SMARSHIFT** gantry stage.



EUV Lithography

The breakthrough in world wide's digitalization would not be possible without the latest generation of integrated circuits made by EUV lithography. Both the processing of wafers by EUV light as well as EUV metrology for components like EUV masks require ultra-precise positioning

technology. Often, systems are operated in harsh environments with vacuum and high-energy radiation, allowing only a limited selection of materials.

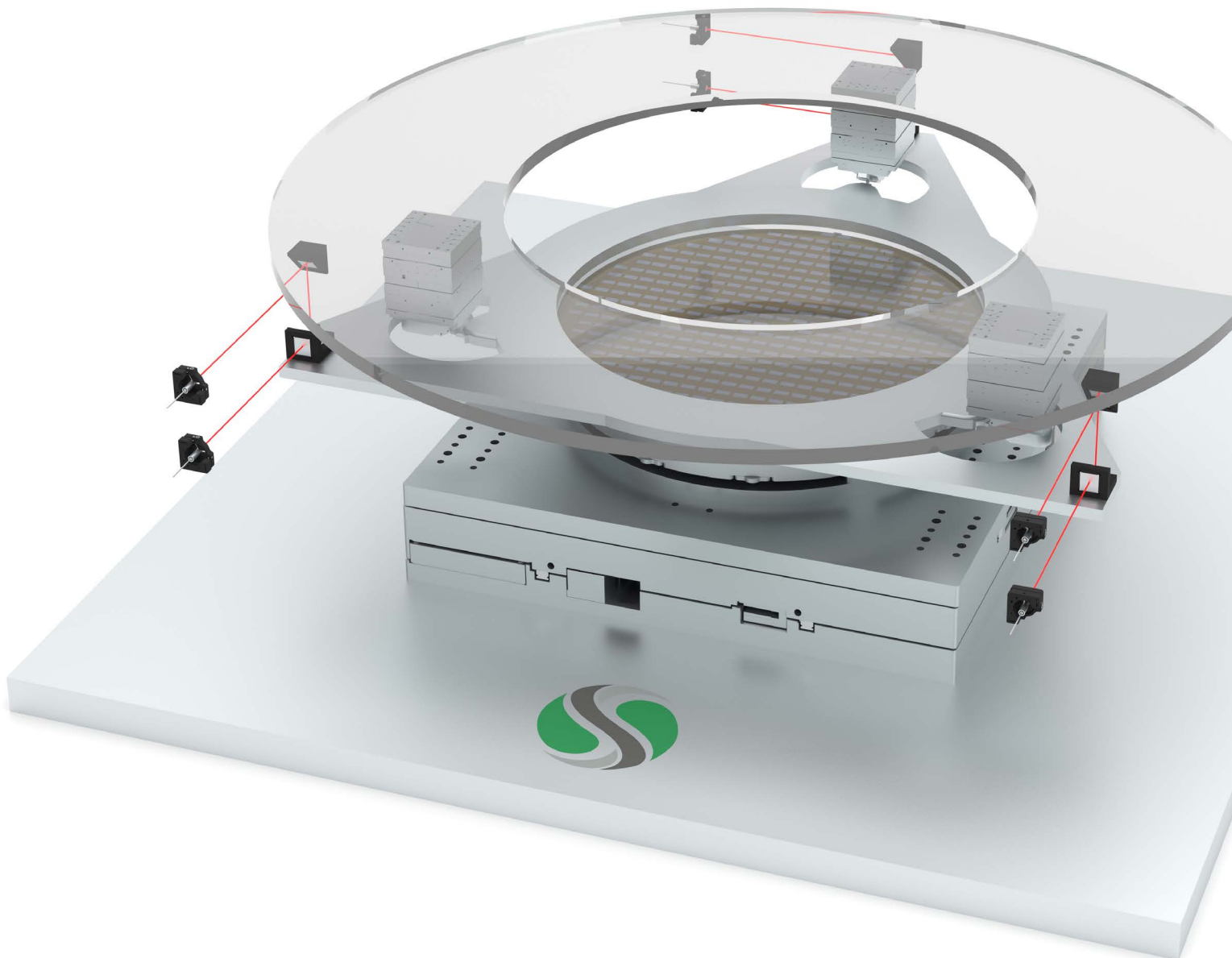
Our portfolio addresses these challenges with positioning systems based on **SMARSLIDE** piezo inertia drive technology as well

as complex **SMARBOTIC** parallel kinematics. These systems combine the benefits of a highly compact footprint and extreme precision, made by materials perfectly matching the special requirements of EUV applications.

Lithography Mask Correction

In lithography, which is an essential technique for the fabrication of integrated circuits, structures down to nanometer size are transferred from photomasks to wafers. Any misalignment leads to mistakes in the patterns on the wafer and by that, to defective devices. Various correction techniques can help to minimize failures in the lithography process. We offer positioning solutions combined with

interferometry by **SmarAct Metrology** to correct the position of devices with nm accuracy in up to six degrees of freedom. **SMARFLEX** piezo scanners with travel ranges of 200 μ m, as well as **SMARSLIDE** piezo inertia drive stages provide the required precision. The result is a perfect alignment of mask and wafer at any time of the lithography process to ensure devices with highest quality.



Optical Assembly

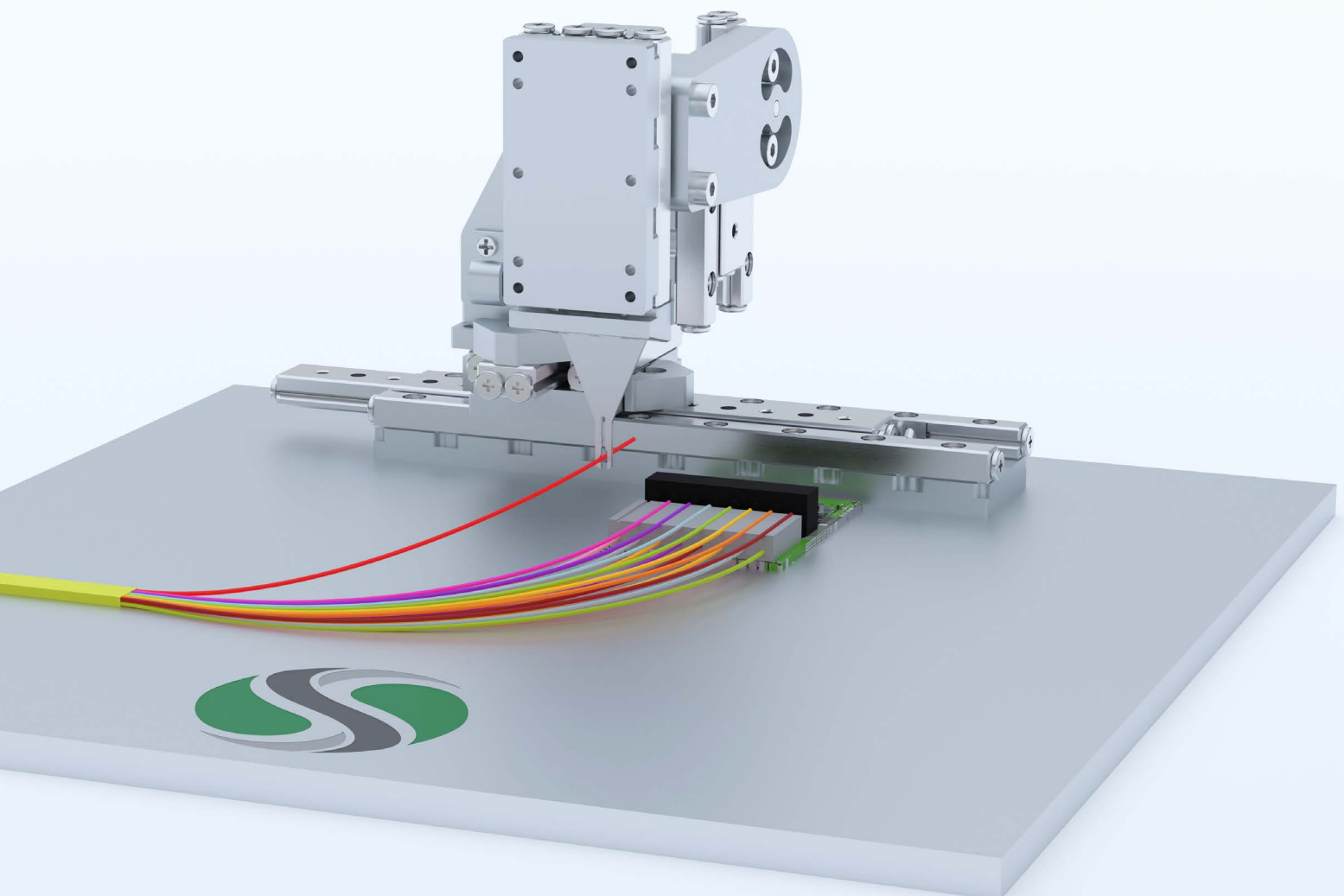
In the world of photonics, many different optical components are used to guide light such as lenses, mirrors, fibers or fiber arrays. To build an optical system, these components need to be either placed and aligned to a certain position, or bonded to another element. For these tasks, compact and delicate grippers and positioning systems of highest accuracy

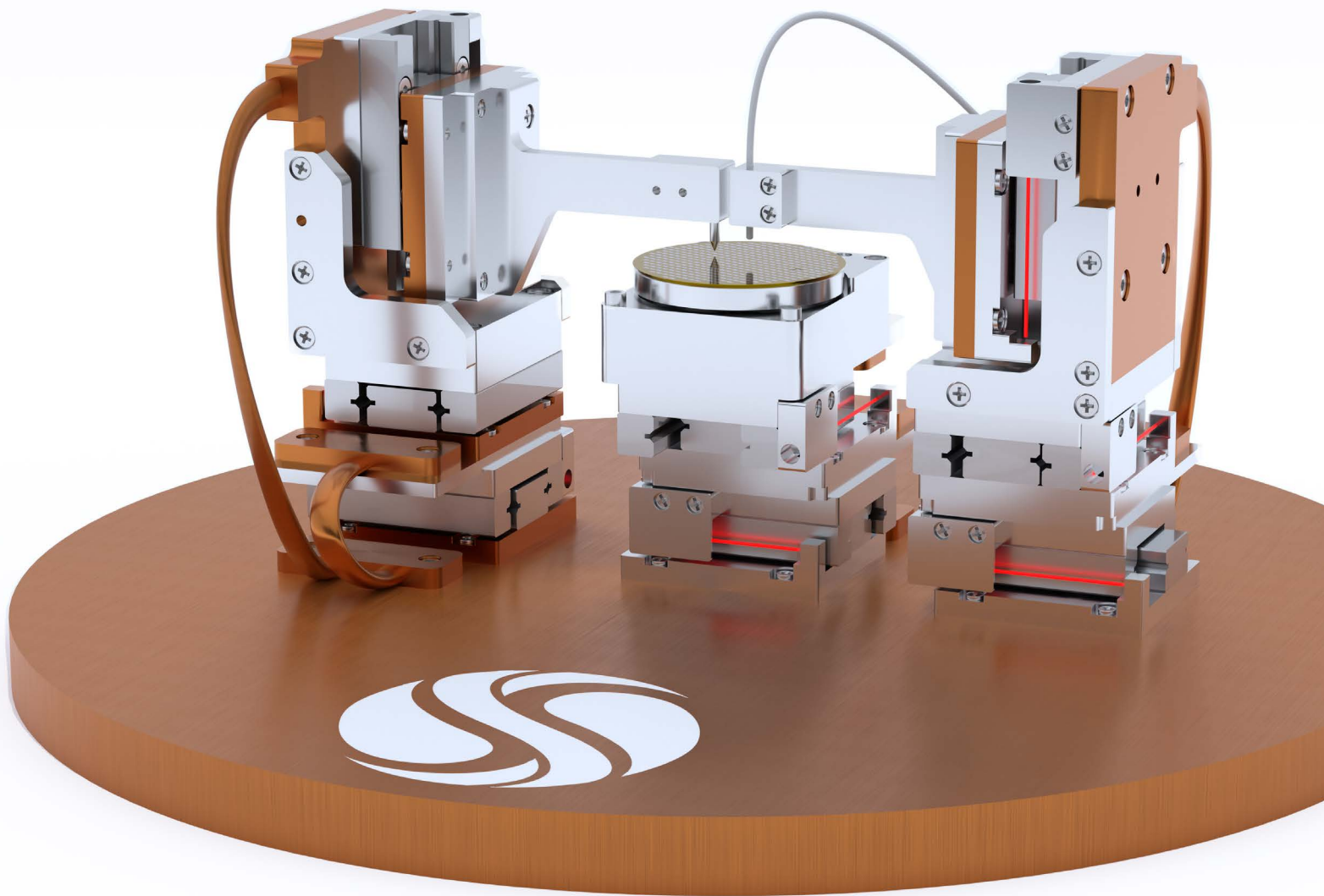
are needed.

We address these challenges with our customizable **SMARBOTIC** serial kinematics, following strict modularity to configure positioning systems with multiple degrees of freedom in many different possible configurations. Micro grippers with exchangeable and adaptable gripper jaws allow gripping of even the smallest optical

components with dimensions of less than 1mm.

The example shows a pick and place system for small fibers, consisting of **SMARSLIDE** piezo inertia drive axes configured as a XYZ-system combined with a gripper. Similar **SMARBOTIC** parallel and serial kinematics can be used to align fibers and lenses and even for bonding applications.





Quantum Computing with Cryo Stages

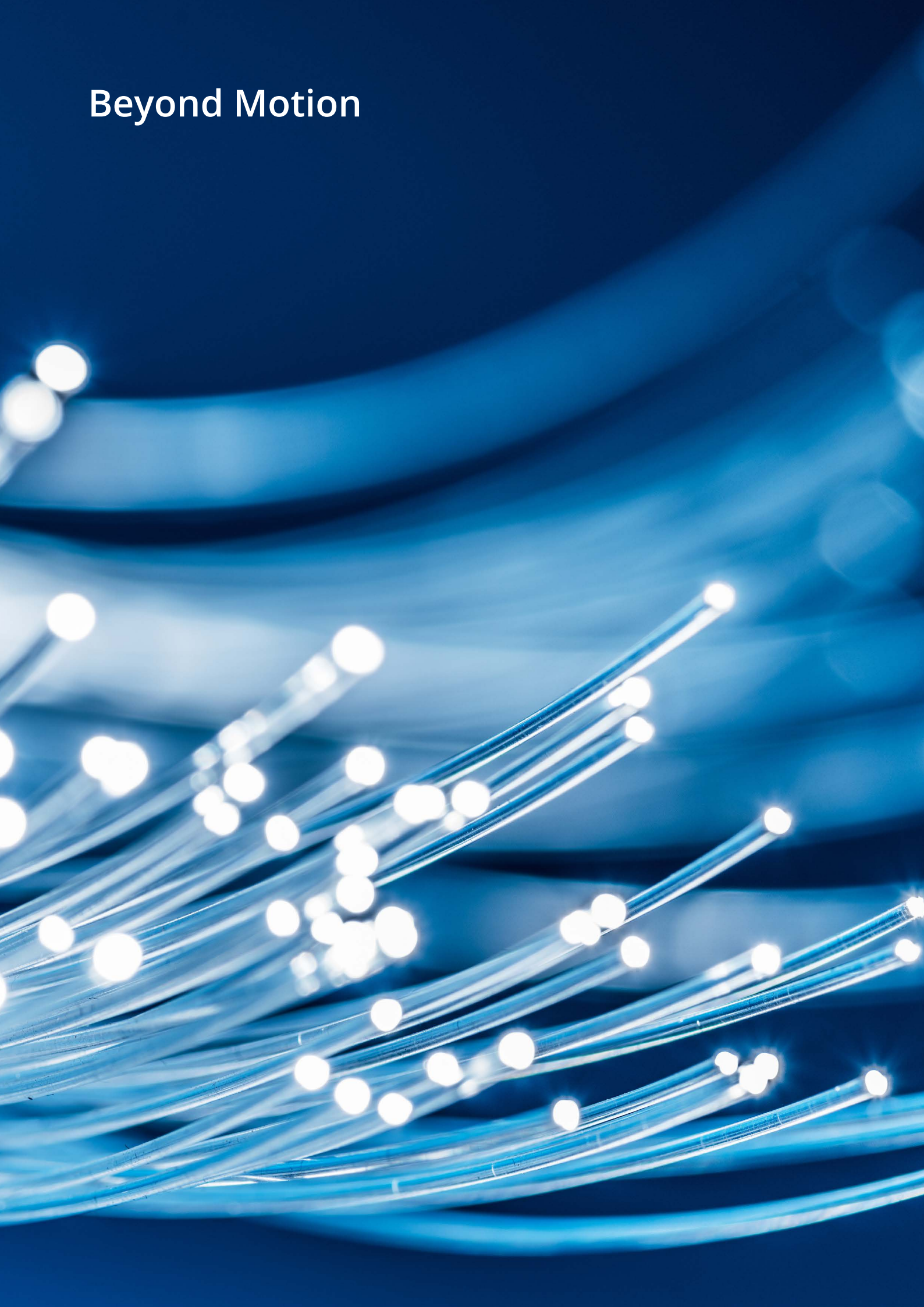
Quantum technology has moved from laboratories to technical applications in recent years. The biggest obstacle with quantum devices is the extreme environment in which they get manufactured and operate. For this application, systems must function under cryogenic temperature, high pressures and magnetic fields.

Our cryogenic positioning system, composed of easily combined titanium linear

stages, holders and adapter plates, is a compact, modular and highly precise multi-axis setup that can be the perfect match for your quantum computing applications. Whether you need a XYZ System for light and electrical probing or a XYR System with a rotation stage to simply hold and position your sample, this product is the right choice for your application. It is equipped with cold plates and copper braids to ensure optimal heat transfer from the

payload to the mounting base plate. This always ensures low temperatures. The entire system as well as every single component can be customized to suit even the smallest available footprints and be connected to the cold fingers of a cryostat in the customer setup. The combination with SmarAct Interferometer as closed-loop feedback allows unmatched accuracy and stability even at mK temperatures.

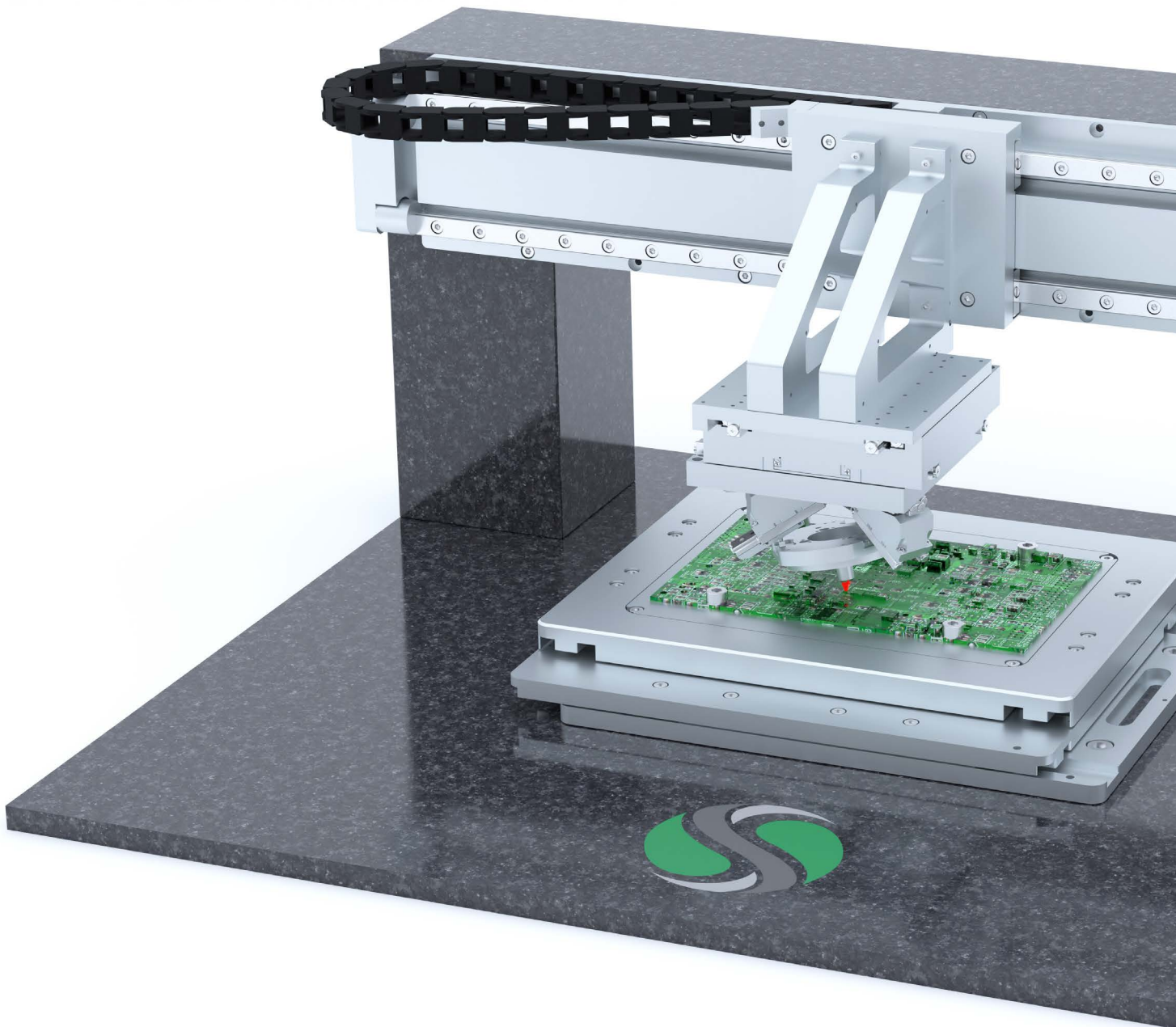
Beyond Motion

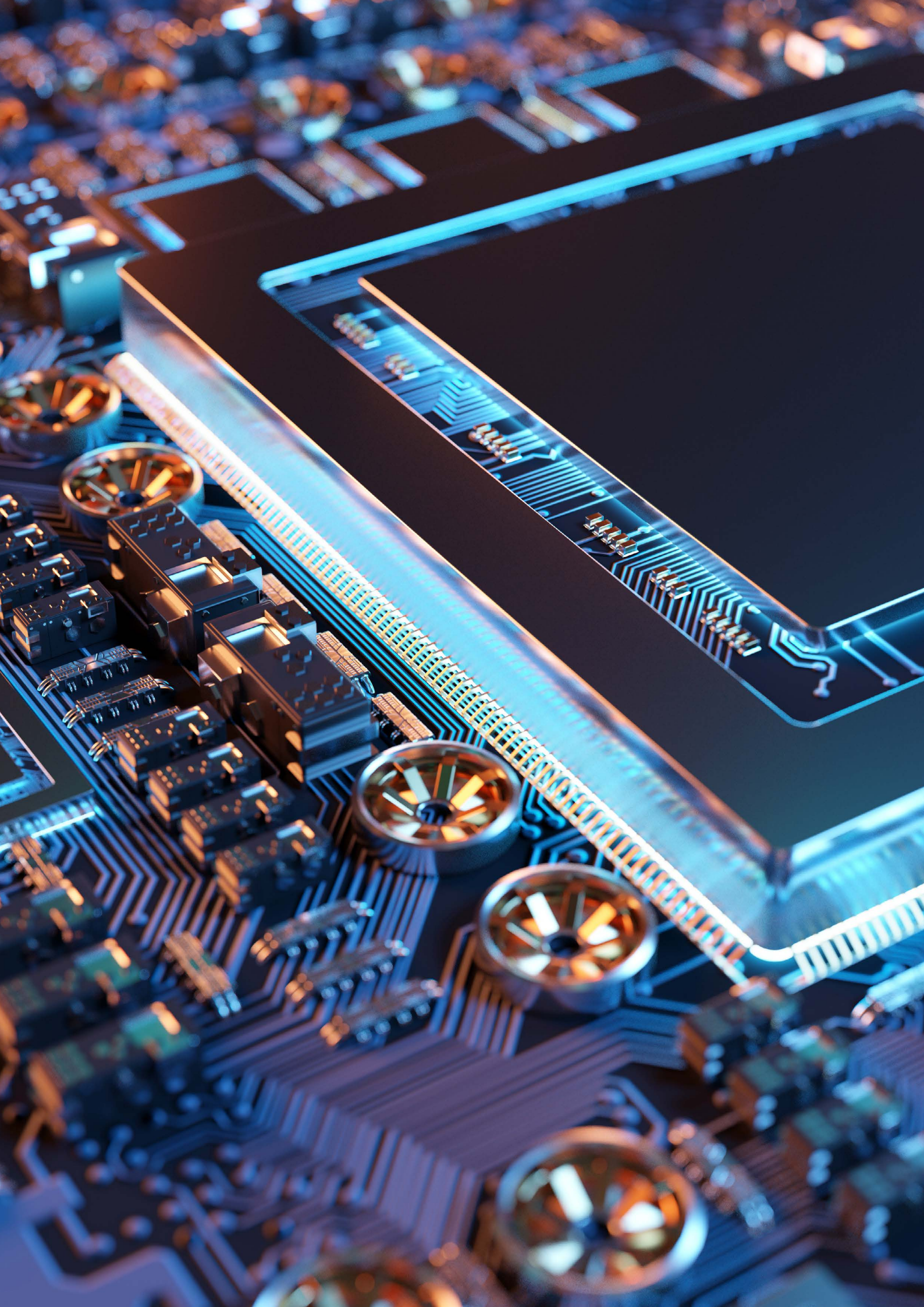


Optical Characterization

Most consumer devices are based on miniaturized opto-electronic or electro-mechanical components like micro displays, optical sensors and loudspeakers. For the challenging test and characterization of such components, SmarAct offers individual solutions that combine

high-precision positioning with optical and tactile metrology. E.g., for the optical characterization of micro LEDs, a **TRIPOD** can be used to scan the output power by tilting a sensor around each LED.

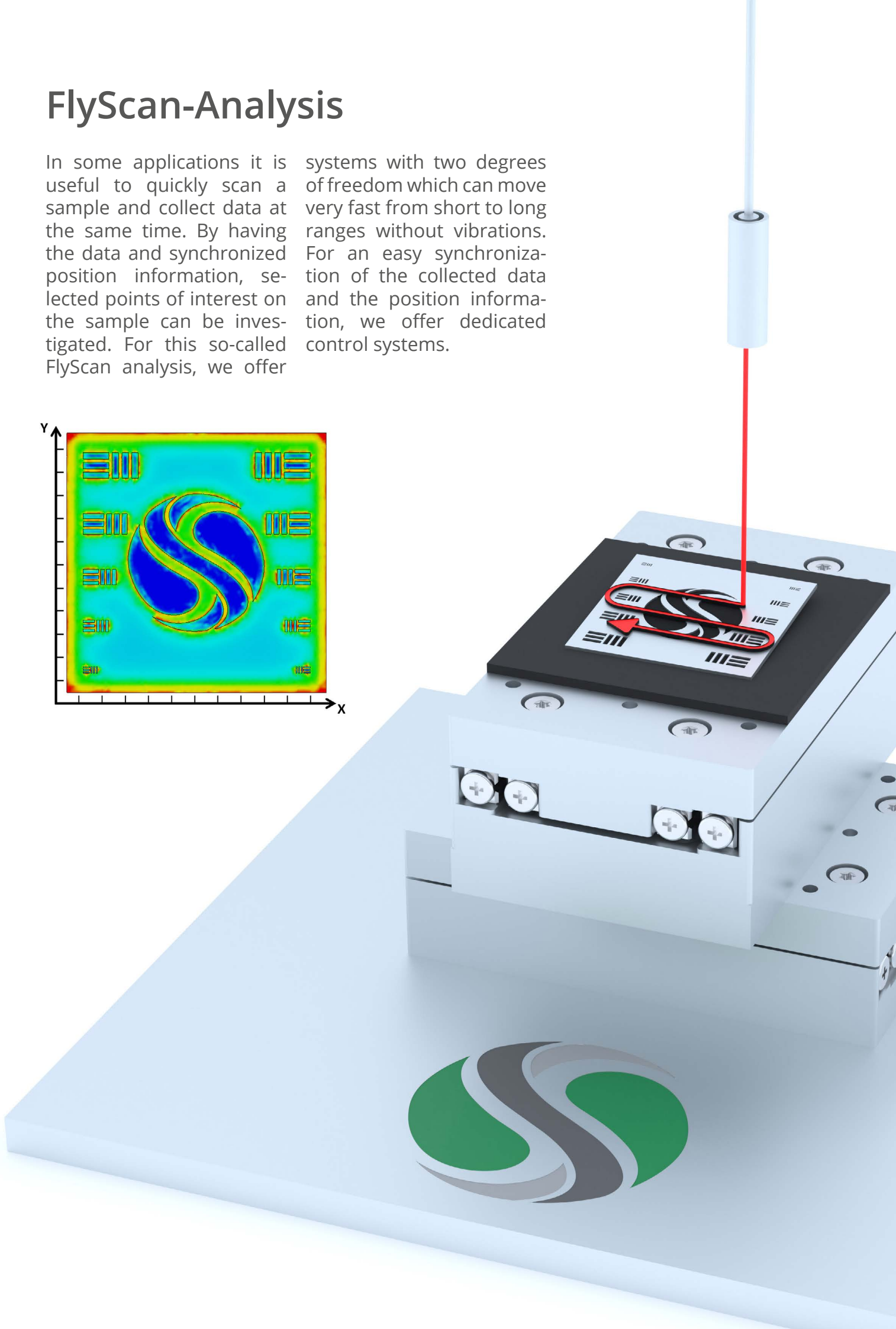
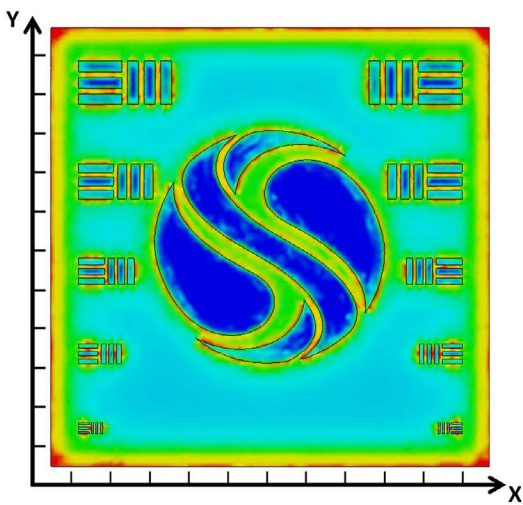




FlyScan-Analysis

In some applications it is useful to quickly scan a sample and collect data at the same time. By having the data and synchronized position information, selected points of interest on the sample can be investigated. For this so-called FlyScan analysis, we offer

systems with two degrees of freedom which can move very fast from short to long ranges without vibrations. For an easy synchronization of the collected data and the position information, we offer dedicated control systems.





Electrical Probing

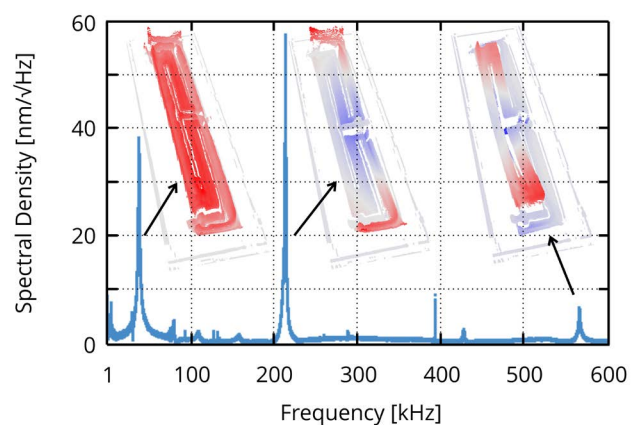
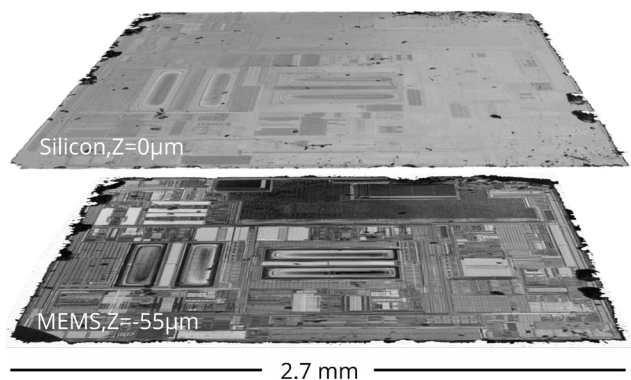
Electrical probing is crucial in several semiconductor applications to test electric properties of devices. We provide automated probing solutions for different levels of structure sizes in various environments – from coarse probing in atmospheric conditions under a light microscope to fully automated probing of down to 3nm technology nodes inside a scanning electron microscope.

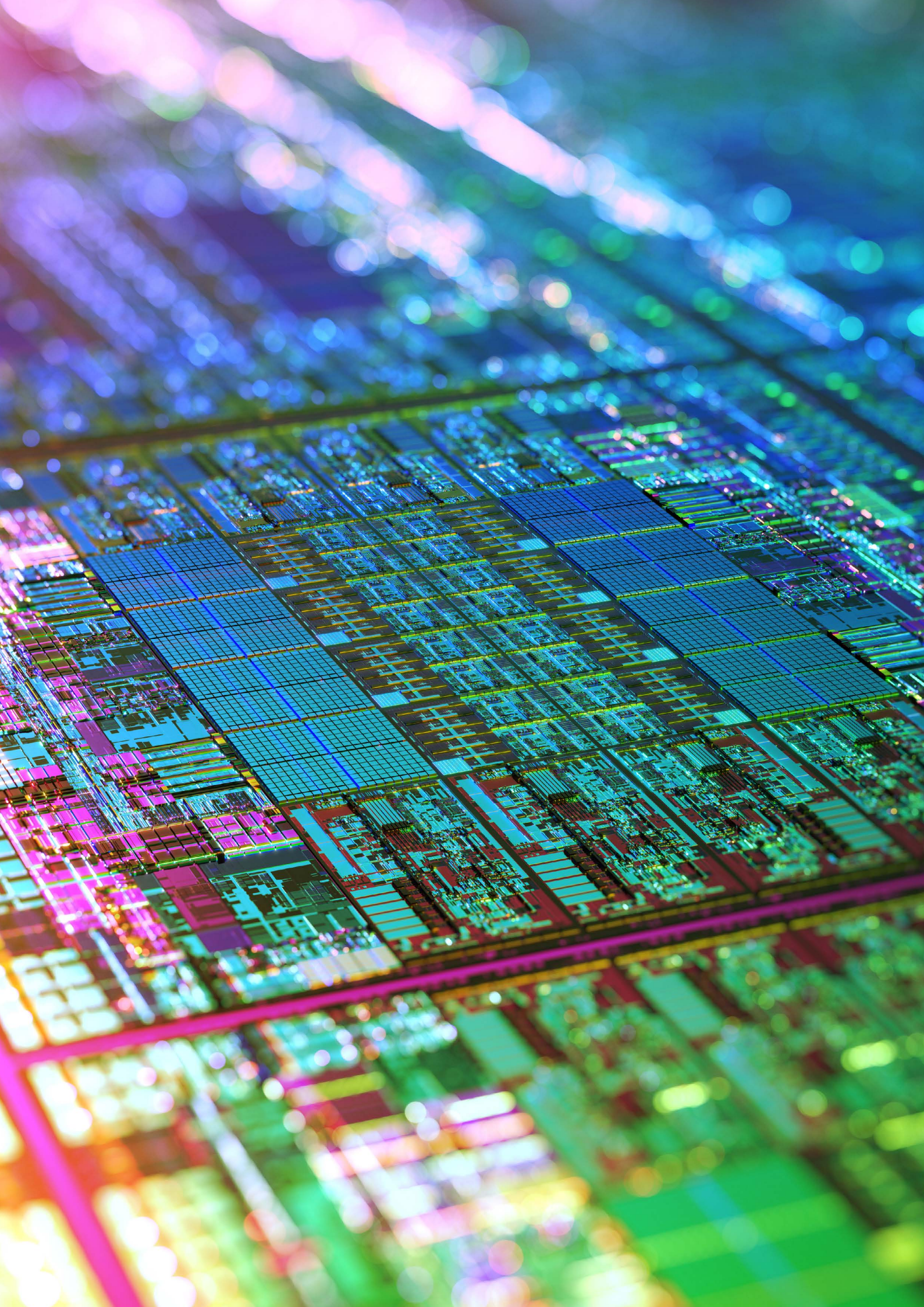
Dedicated products like the **SMARPROBE** nanoprobe, provided by SmarAct Metrology, offer the full comfort of a fully integrated solution. On the other hand, any of our probing technology can be implemented in smaller stand-alone positioning systems, with the possibility to be combined with other technologies like optical probing or vibrometry.

Vibrometry for MEMS

Measuring vibrations of MEMS through a packaging of silicon is made possible by confocal imaging with an IR light source. SmarAct Metrology's PicoScale Vibrometer is a turnkey solution to measure vibrations of micromechanical structures with sizes that range from just a few μm to multiples cm. Therefore, the selective imaging of layers with infrared confocal microscopy can be made possible. They can measure through semi-transparent materials such as glass and silicon as well as semi-transparent structures when in focus.

In-plane motion is imaged by recording a sequence of microscopy images that span exactly one vibration cycle, like stroboscopic imaging. In plane vibrations down to 10nm can be extracted through optical flow algorithms.





Automated Microassembly Stations

SmarAct Automation provides automated microassembly solutions tailored to your needs. We are a reliable partner for customers who want to transfer their prototype into serial production, aim to automate an otherwise manual task or increase their production output.

In our application laboratory we devise mock-up systems to understand your product, evaluate high risk process steps and develop the manufacturing processes directly on one of our P50 production platforms. Our team of mechanical,

electrical and software engineers have access to a vast variety of tools and machining equipment to ensure short development cycles and to identify the best concept for your product.

With a suitable concept at hand, we provide a turnkey solution to you, including operator training and various maintenance or service options. Alternatively, we use our in-house production capabilities to manufacture parts for you by means of contract manufacturing.

SmarAct | automation

P50



With the development and production of market-leading solutions in the field of high-precision positioning, automation and metrology, the SmarAct Group reliably accompanies their customers in achieving their goals. The broad product portfolio – from single positioning stages to complex parallel kinematics, miniaturized robots, control systems and measurement technology – is complemented by automated microassembly solutions. Even the most challenging customer requirements can be met by maximum adaptability and complete in-house production.

Since its founding in 2005, SmarAct has steadily grown from a small team of engineers to a group of companies with three independent business units and over 220 highly skilled members. Today, SmarAct relies on years of experience and, above all, on a very passionate team with unconditional customer focus.

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