Published in Photonics Media on February 28, 2022

NOVEL MICRO-OPTICS SOLUTIONS THROUGH MONOLITHIC INTEGRATION OF MICROLENSES AND PRISMS

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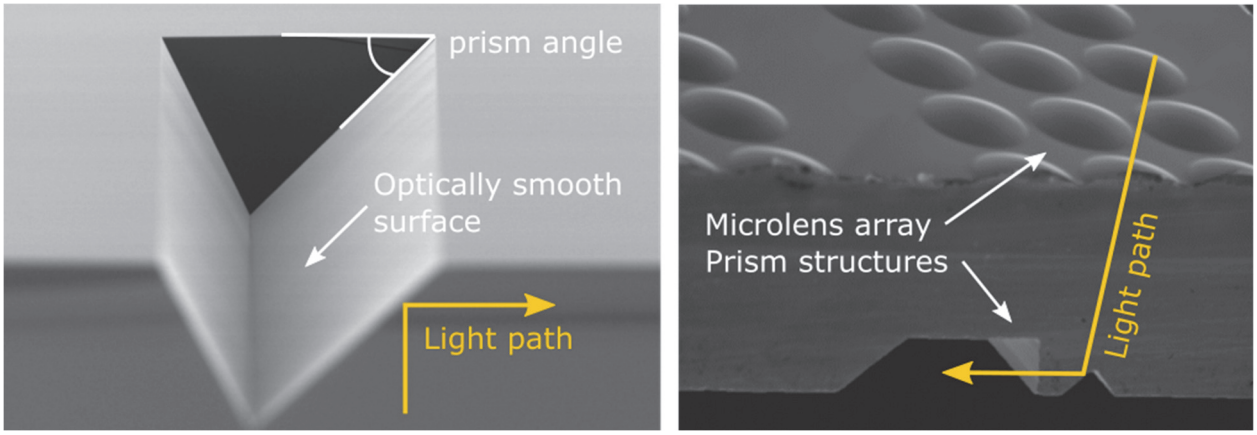
White Paper

Novel micro-optics solutions through monolithic integration of microlenses and prisms

Megatrends such as 5G, the Internet-of-Things, autonomous driving and commoditized healthcare are heavily based on photonic and optical solutions. The engineering of the often complex and costly optical devices towards mass-market compatible size, weight and power (SWaP) and cost targets drives constant manufacturing innovation.

Lenses and prisms are among the oldest and most ubiquitous optical components and even today mastery of their design and manufacturing enables technological leadership. As optical devices constantly shrink and increasingly employ fabrication processes derived from semiconductor technology, combining lenses and prisms at the micro-scale is of great interest.

SUSS MicroOptics is a global leader in micro-optics technology and manufacturing. Its customized refractive and diffractive micro-optical solutions serve more than 150 customers in highly diverse markets ranging from semiconductor, telecom, automotive to medical. Recently, innovative combination of process technology has allowed SUSS MicroOptics to integrate lenses and prisms on the micro-scale.



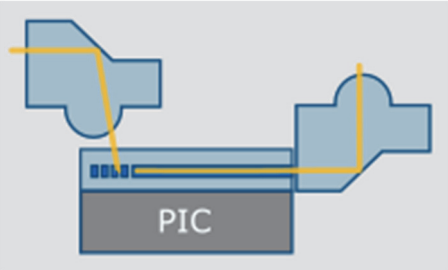
The above figures show examples of prism surfaces and microlenses structured into a Silicon substrate. Through reflection at the interface between the air and the bulk Si the light is redirected parallel to the substrate surface. The manufacturing process enables great design freedom as quantified by the guideline values in the below table:

Materials	Silicon, Fused silica
Prism angle	0° up to 80° from substrate surface
Prism depth	Up to 0.5 mm into the bulk substrate
Placement accurancy	Down to 3 µm with respect to other structures

Beyond microlenses, features such as cavities and optically smooth sidewall surfaces are often required for beam expansion or as coupling facets. SUSS MicroOptics offers processes for both as well as a wide range of AR coating, metallization and glue management options. This comprehensive offering provides a powerful toolbox for miniaturization and integration of scalable optical solutions.

In the following, examples are show-cased for the innovative designs enabled by the combination of a microlens and a prism in different applications.

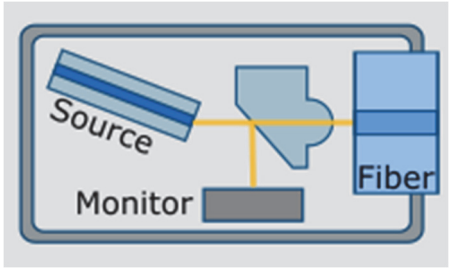
1. Photonic integrated circuits (PIC)



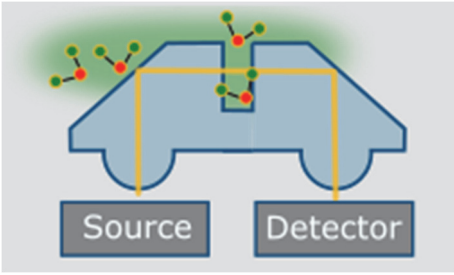
Through on-chip light guiding and manipulation Si photonics or more general photonic integrated circuits have found widespread use in data and telecom devices. Test, assembly and packaging of such devices at scale remains a challenge. Here, the combination of micro-lens and prism opens new venues enabling out-of-plane coupling using edge couplers or into-plane coupling of prism couplers.

2. Optical subassemblies and transceivers

Increasingly challenging requirements for power consumption and form factor drive development of many optical subassemblies as found in DWDM transceivers and components. Despite their considerable volume, some designs incorporate a set of high performance micro-optical components, including several lenses and prims. Compact integration of both provides an enticing solution, relaxing form factor requirements and simplifying assembly.



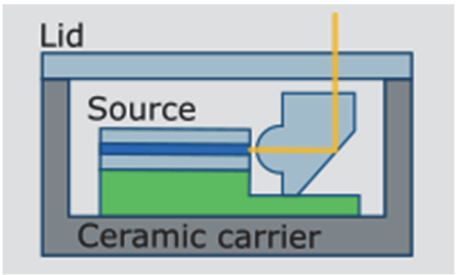
3. Environmental sensing, point-of care and wearable diagnostics



Optical principles are widely used in environmental monitoring of e.g. CO2 and VOCs. Also the acquisition of healthcare data, e.g. heart rate and glucose, in consumer wearables is optics based. Providing a well-controlled and robust interaction volume for the light and the analyte of interest is paramount to good sensing performance. The microprism allows to miniaturize the transmission or evanescent field based probes known from large-scale analytic equipment.

4. Autonomous driving and LIDAR

LIDAR, as key enabler of autonomous driving systems, challenges engineers to conceive mass-manufacturing compatible optical solutions with automotive grade reliability. SUSS MicroOptics monolithic co-integration of microlens and prism enables a maximum of reliability while providing semiconductor production scalability for critical beam forming and directing elements.



For more information, please get in contact with us: sales.smo@suss.com