Fraunhofer ISIT

Micro-Optical assembly on wafer level

Technology offer demonstrated on a RGB light engine

Silicon optical bench

Motivation

Digitally enhanced living and autonomous driving, drones and multiple 3D object recognition tasks drive the development of small, cost-efficient micro-optical systems. Assembling these systems involves certain challenges. The assembly process must feature automated handling and component alignment functions. The required high precision demands for a stable assembly substrate platform.
A silicon wafer is a well-suited substrate as optical integration platform, offering a low coefficient of expansion, high mechanical stiffness, and sufficient thermal conductivity. It features functionalities like very high-definition quality of metallization, different height levels, integrated electrical vias etc. and is gas tight and low outgassing by nature. The micro-optical assemblies can be hermetically housed with an optical interface to the environment. This technology is called wafer level bonding and is well known from the production of inertial and µ-bolometer sensors. The process seals all assemblies on a wafer substrate in one single step. Also, laser diodes take advantage of a sealed environment for reliable operation. The glass wafer capping technology of ISIT provides the required optical interface in side or top looking configuration for laser diodes while it encloses a protective gas atmosphere.

Achievements

A miniaturized RGB laser light engine is an example application to demonstrate the heterogeneous micro-optical integration on a Silicon optical bench. The assembly process may be performed on full wafer-level, on panels or on single substrate. Working with full wafers enables the wafer bonding with glass cap wafers and enables defined work atmospheres. This approach takes most advantage of our modular glass-Silicon packaging platform, which is designed and manufactured in our own cleanroom with the requirements of the assembly procedure in mind. ISIT established the required infrastructure and basic routines from automated component feeding over precision passive placement on wafer substrate and active lens adjust, wire bonding on wafer level to hermetic glass cap sealing. In-situ laser soldering and in-situ UV adhesive curing prevent any shift in component placement due to substrate transportation. Depending on the component geometries and their specific characteristics, both vacuum suction and gripper handling may be used. The combination of stencil printing, SMD passives pre-assembly, direct die attach in a die bonder and sophisticated micro-optics precision assembly all on up to 8" wafers is a unique concept available at ISIT. Each machine does what it does the best.

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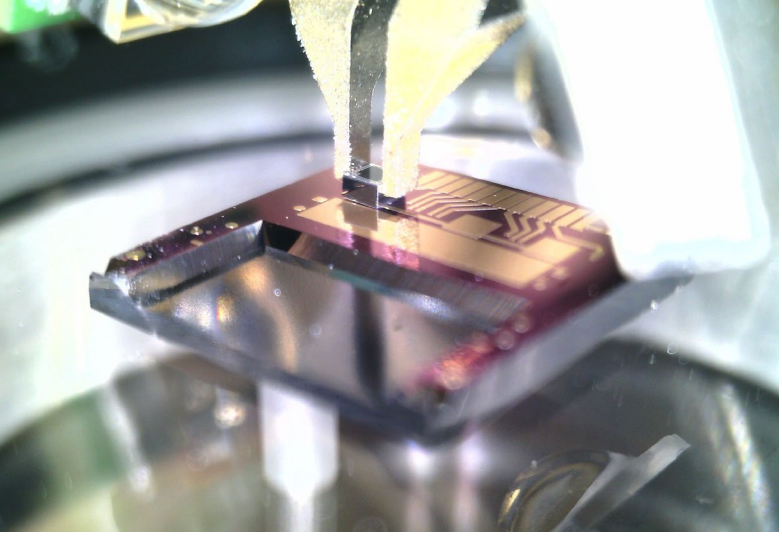
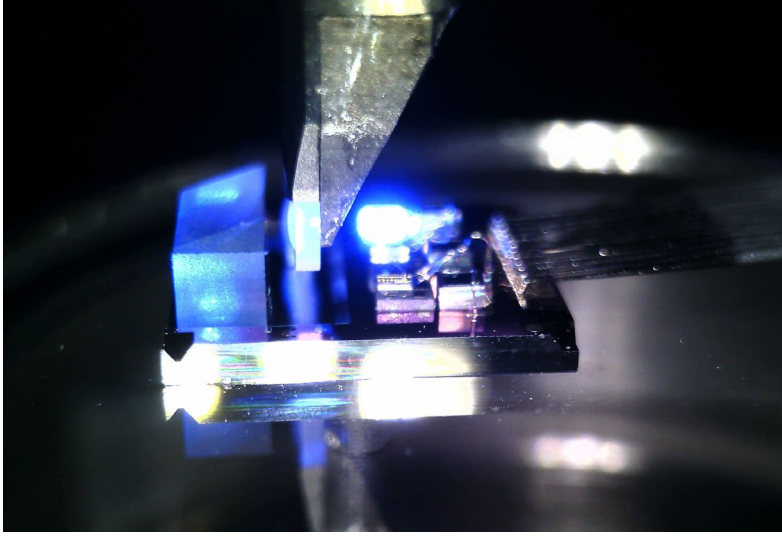


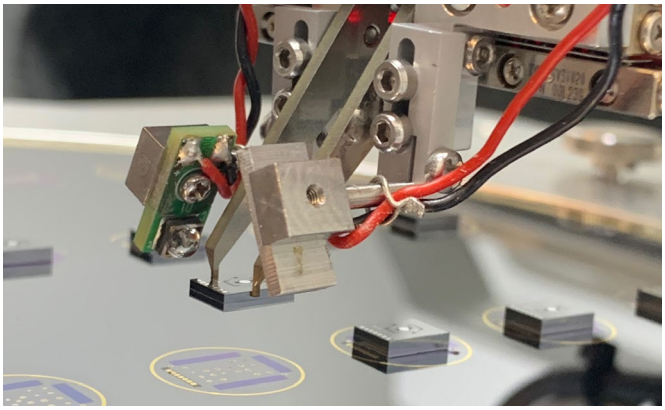
Component assembly with gripper



Active lens adjust

Your Benefits

The ready to go assembly infrastructure together with the in-house wafer processing offer a unique development environment. The parallel quality and reliability assessment with a multitude of inspection techniques and the FMEA methodology from design to production complete the development surroundings. Your risk investment, NRE and time constraints can therefore considerably be reduced. The on-site presence of your engineers during important development steps anchor your involvement and teaching of your personnel for later investment decisions.



Assembly of MEMS mirrors
on Si interposer

Our Service

Feasibility Studies

We are searching for answers to our customer's questions for the best possible automated assembly solution.

Silicon optical platform

Our MEMS clean room features a plentitude of processing options for silicon and glass wafers. Lateral and vertical electrical vias provide the second level interconnection interface. Dedicated post-CMOS wafer processing enables highly functionalized substrates.

Glass and silicon cap wafer

Capping wafers provide the assembly cavity and optical windows with unique geometries. Seal frame, anti-reflective coating and getter integration are functionalities that may be included.

Individual assembly solutions

Datacon die bonders and a Ficontec micro-optics assembly station together with Hesse Mechatronics and Palomar large area wire bonders may work together to find assembly solutions for the most challenging tasks.

Technologies

- Technologies
- Bulk and surface micro-mechanical wafer processing
- Post-CMOS wafer processing
- Hot-viscous glass forming
- Wafer metallization and via integration
- Wafer grinding and dicing
- Wafer bumping and Au stud bumping
- Glass and metallic seal wafer bonding
- Die- and flip chip attach
- US- and TS wire bonding
- In-situ laser soldering
- Vertical die stacking with relative adjust
- Lateral component movement relative to a reference during assembly
- Tilted component assembly with in-situ UV adhesive cure
- Active lens adjust with near field characterization

Fraunhofer ISIT
is participant of the
Forschungsfabrik
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