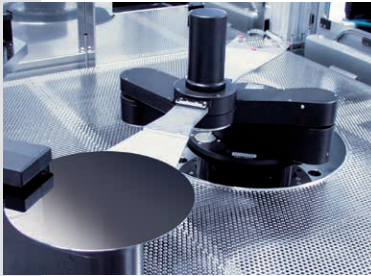
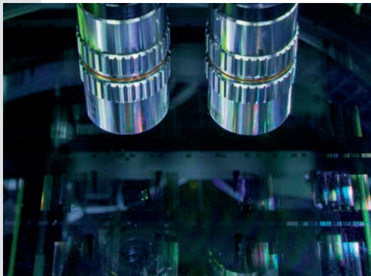
EV GROUP® | Technologies

Solutions for MEMS





Introduction

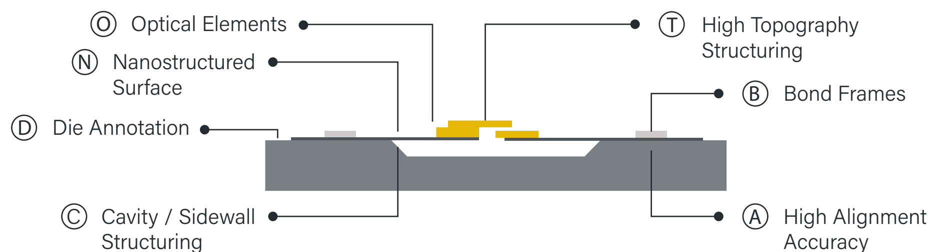
Today, micro-electro-mechanical systems (MEMS) devices are present in almost every technology of daily life. Smartphones are a prominent example of consumer devices that incorporate multiple MEMS devices, such as accelerometers and gyroscopes for motion sensing and MEMS-based filters for wireless communication.

MEMS are also a key technology for the automotive industry, ranging from pressure sensors in engine management or tire pressure monitoring systems to accelerometers in airbag release systems. In particular, MEMS devices for automotive and industrial applications must meet the highest standards of performance and reliability, which also place the highest demands on manufacturing technologies.

EVG has a long history as a leading supplier of wafer processing equipment for the MEMS market. Today, excellent process know-how, continuous innovation and a broad product portfolio in the areas of lithography and wafer bonding ensure that MEMS customers are supported in developing leading-edge solutions for their next-generation devices.

Lithography

Most MEMS devices consist of 3D structures with high topography and small fragile moving parts. Manufacturing processes therefore require thick resist processing, conformal coating over topographies combined with excellent exposure and alignment capabilities. In addition to standard UV lithography, nanoimprint lithography (NIL) even offers nanostructuring for emerging MEMS applications. Furthermore, maskless exposure (MLE™) technology enables dynamic patterning of photoresist, including the possibility of individual die annotation - an important feature for critical automotive and industrial MEMS applications.



Advanced resist processing Ⓑ Ⓒ Ⓣ

- Spin and spray coating capabilities
- Multilayer processing
- Specialty resist processing
- Spray, puddle, stream and ultrasonically assisted development

High accuracy mask alignment Ⓐ Ⓑ Ⓒ Ⓣ

- Lithography for etching and metallization
- Latest UV-LED technology
- High depth-of-focus exposure
- Bond alignment

Digital Manufacturing with Maskless Exposure Technology (MLE™) Ⓓ Ⓐ Ⓑ Ⓒ Ⓣ

- Dynamic photoresist patterning with < 2 µm line / space resolution
- Individual patterns from die annotation to multi-project wafers
- Mask-free digital infrastructure
- Smart & agile from fast prototyping to mass-manufacturing

Nanoimprint Lithography (NIL) for highest resolution Ⓞ Ⓝ

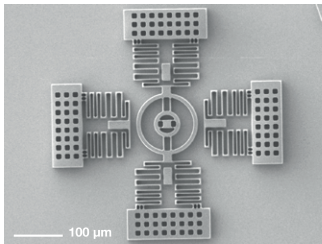
- Volume-proven wafer-level imprinting technology
- Proprietary SmartNIL® technology
- Leading-edge wafer-level-optics capabilities
- Innovative processing for Bio-MEMS

MEMS Devices

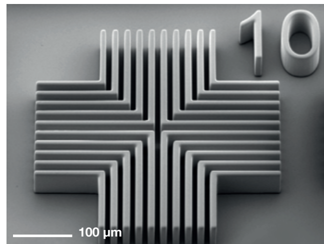
Gyroscopes
Environmental Sensors
Ultrasonic Sensors
Microphones
RF MEMS
BIO MEMS
EMERGING MARKETS
CONSUMER
Accelerometers
Gas Sensors
Pressure Sensors
AUTOMOTIVE / INDUSTRIAL
Inkjet Printheads
Magnetometers
Inertial Measurement Units
Optical MEMS

Process Results

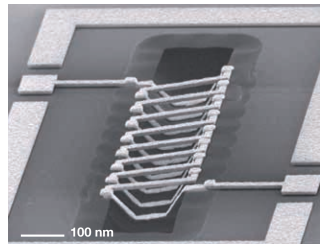
Lithography



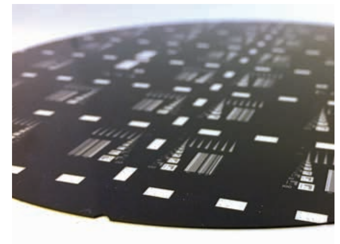
MEMS Structures patterned in 20 µm thick resist
Source: EVG



MLE™ exposure in 50 µm thick layer JSR THB 151N negative tone resist
Source: EVG

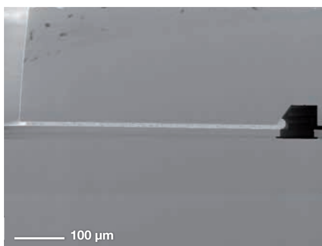


High-Q-3D solenoid inductors for RF ICs. Metal structures created using spray coating
Courtesy of SIMIT

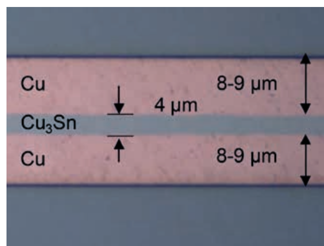


20 µm thick black resist spin-coated double layer on 8″ substrate exposed on EVG®6200 NT **Source: EVG**

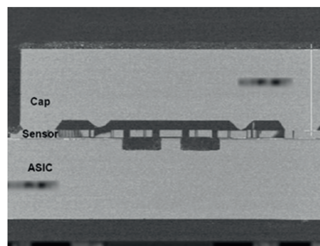
Bonding



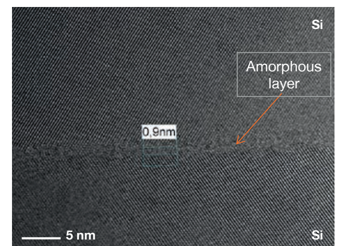
Glass-frit bond interface
Courtesy of ST Microelectronics



Cross section of a Cu:Sn bonding layer
Courtesy of Siemens



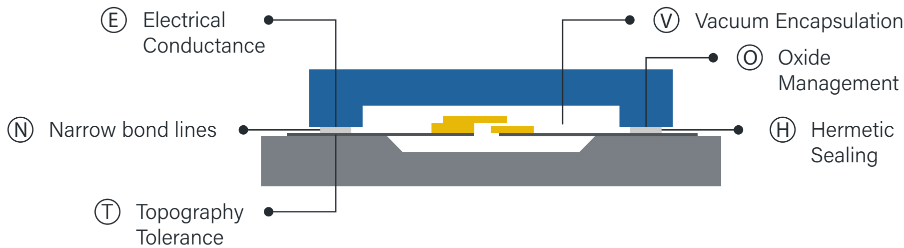
SEM image of a MEMS device bonded to an ASIC using Al-Ge eutectic bonding system
Courtesy of Chipworks

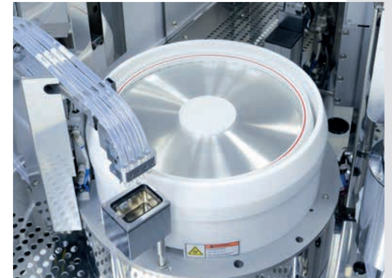


Oxide-free silicon-silicon interface
Source: EVG

Wafer Bonding

Many MEMS devices need to be protected from the external environment or operate only under controlled atmosphere or vacuum. Today's high levels of integration with CMOS chips also require advanced wafer-level packaging solutions for MEMS devices. In addition, many MEMS are based on technical substrates such as SOI wafers. Therefore, wafer-level bonding processes play a crucial role in the manufacture of MEMS device.





Metal bonding for hermetic sealing and vacuum encapsulation Ⓔ Ⓥ Ⓗ Ⓝ

(Solder, Eutectic, Transient Liquid Phase (TLP), Metal Diffusion)

- Defined pressure encapsulation
- Good mechanical strength
- High post-bond alignment accuracy
- Versatile interface properties

Fusion bonding for engineered substrates Ⓥ Ⓗ

- MEMS-SOI substrates
- Hybrid bonding
- Collective die transfer
- Heterogeneous integration for advanced semiconductor packages

Anodic bonding for reliable silicon-glass interfaces Ⓥ Ⓗ

- Highly stable and strong bond
- Optical transparency
- Triple-stack bonding (Si-glass-Si)
- High post-bond temperature tolerance

Topography tolerance with glass-frit bonding Ⓥ Ⓣ Ⓗ

- Intermediate glass layer
- Wide process window
- Planar electrical feedthroughs
- Production proven for decades

Adhesive bonding for simplified integration Ⓣ Ⓗ

- Temporary bonding / debonding
- Room-temperature bonding with UV-curing adhesives
- Ultra-thin adhesive layer transfer bonding
- Compatible with a wide range of substrate materials

High-end packaging with ComBond® technology Ⓞ Ⓔ Ⓥ Ⓗ Ⓝ

- High-vacuum handling and processing (<7E^{-8} mbar)
- Vacuum encapsulation without getters
- Low-temperature Al-Al bonding
- Wafer surface activation

Process Services and Competence Center

With state-of-the-art application labs and cleanrooms at its headquarters in Austria, as well as in the U.S. and Japan, EVG is focused on delivering superior process expertise to our global R&D and production customer and partner base. Services range from equipment demonstrations and feasibility studies to small-to-medium-scale pilot-line production to shorten time to market. EVG has also established the Heterogeneous Integration Competence Center™, which is designed to assist customers in leveraging EVG's process solutions and expertise to enable new and enhanced products and applications driven by advances in system integration and packaging.

MEMS Devices

EMERGING MARKETS

Gyroscopes

Environmental Sensors

Ultrasonic Sensors

Microphones

RF MEMS

BIO MEMS

CONSUMER

Accelerometers

Gas Sensors

Pressure Sensors

Inkjet Printheads

Magnetometers

Inertial Measurement Units

Optical MEMS

AUTOMOTIVE / INDUSTRIAL

Product Range Excerpt

Lithography

EVG®610
Mask Alignment System
up to 200 mm

EVG®7300 Automated
SmartNIL® UV-NIL System
up to 300 mm

LITHOSCALE® Maskless Exposure
Lithography System
up to 300 mm

HERCULES®
Lithography Track System
up to 300 mm

Bonding

EVG®501 / EVG®510
Wafer Bonding System
up to 200 mm

GEMINI® Automated Production
Wafer Bonding System
up to 300 mm

ComBond® Automated High-Vacuum
Wafer Bonding System
up to 200 mm

EVG®850 TB Automated
Temporary Bonding System
up to 300 mm

Headquarters

EV Group Europe & Asia/Pacific GmbH
DI Erich Thallner Strasse 1
4782 St. Florian am Inn
Austria
+43 7712 5311 0
Sales@EVGroup.com
TechSupportEurope@EVGroup.com

EVG Subsidiaries

North America
EV Group Inc.
+1 480 305 2400
SalesNorthAmerica@EVGroup.com
TechSupportNorthAmerica@EVGroup.com

Japan
EV Group Japan KK
+81 45 348 0665
Sales@EVGroup.jp
TechSupportJapan@EVGroup.com

Korea
EV Group Korea Ltd.
+82 2 3218 4400
Sales@EVGroup.co.kr
TechSupportKorea@EVGroup.com

China
EV Group China Ltd.
+86 21 3899 4888
Sales@EVGroup.cn
TechSupportChina@EVGroup.com

Taiwan
EVG-JOINTECH CORP.
+886 3 516 3389
Sales@EVG-Jointech.com.tw
TechSupportTaiwan@EVGroup.com

Get in touch:

Contact@EVGroup.com

www.EVGroup.com/technologies

The information contained in this document is provided "as is" and without warranty of any kind, express or implied. Any express or implied warranties including, but not limited to, any implied warranty of merchantability, fitness for a particular purpose, and patent infringement or other violation of any intellectual property rights are hereby expressly disclaimed.
EVG makes no representation that the use or implementation of the information contained in this document will not infringe or violate any copyright, patent, trademark, trade secret or other right.
In no event shall EVG be liable for any claim, damages or other liability, including any general, special, indirect, incidental, or consequential damages, whether in an action of contract, tort infringement, misappropriation or otherwise, arising from, out of or relating to the use or inability to use the information.
Acceptance and/or any use of the information contained in this document shall be deemed consent to, and acceptance of, this disclaimer.

Data, design and specifications may not simultaneously apply; or may depend on individual equipment configuration, process conditions and materials and vary accordingly. EVG reserves the right to change data, design and specifications without prior notice.
All logos, company names and acronyms or any combinations thereof, including, but not limited to, EV Group®, EVG® and the Triple i logo, equipment and technology names and acronyms such as GEMINI®, HERCULES®, BONDSCALE®, SmartView®, SmartNIL® and many others, as well as website addresses, are registered trademarks and/or the property of EV Group. For a complete list of EVG trademarks visit www.EVGroup.com/Imprint. Other product and company names may be trademarks of their respective owners.

Printed on paper from sustainable sources

© EV Group (EVG). All rights reserved. V22/01