



MEMS/MOEMS FOUNDRY SERVICES

From Design to Complete Instrument Development

INO offers a complete range of MEMS/ MOEMS foundry services. Whether you need a very specific service or a fully-integrated MEMS creation process, we have the resources, expertise, and flexibility to help you reach your goals and deliver results. Our state-of-the-art 4,630 sq. ft. clean-room facility is adapted to the processing of 6" and 8" substrates. Every year INO provides MEMS/MOEMS foundry services to 15 to 25 clients including universities, startups and large companies.

Business Model and Offer

Expertise

- Simulations
- Surface micromachining with multiple sacrificial layers
- Integration of MEMS with CMOS electronics
- Hermetic packaging
- Heterogeneous assembly
- Optical design
- Electronics

MEMS Manufacturing (50 wafers/year; 6 wafers/lot; 3-4 month cycle)

- Simulations and design
- Process flow development
- Prototyping
- Short-series manufacturing
- Extensive testing

MEMS Packaging (200 packages per month*)

- Device packaging using INO standard platforms
- New package design
- Process adaptation and development

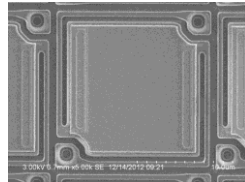
*1" square 68 LCC ceramic package

Other arrangements

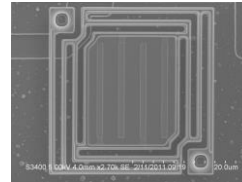
- Technology transfers
- Joint R&D (product development)
- Joint ventures

Basic Building Blocks: Multi-Layer Suspended Platforms

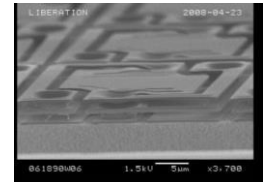
Single and double-level multi-layer platforms



17 μm single-level platform



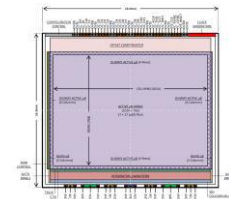
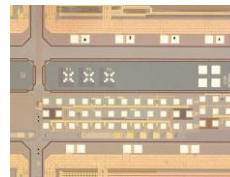
35 μm Single-level platform



25 μm double-level platform

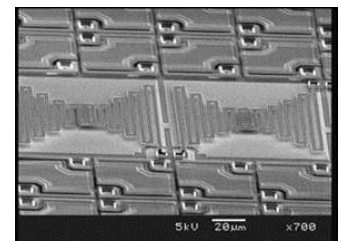
MEMS-CMOS IC INTEGRATION

- Support to design of mixed-signal CMOS ICs compatible with MEMS
- CMOS foundry selection
- Integration with CMOS circuits
- CMOS post-processing for MEMS (wafer coring)



MEMS-Pirani Pressure Microsensors

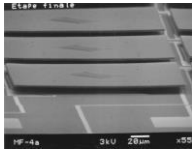
- Sensing devices that can be co-integrated with MEMS devices in packages or on-chip
- Patented measurement technique embedded in control software
- Repeatability (typical): $\pm 1.5\%$ of reading from 3 mTorr to 760 Torr
- Accuracy (typical) $\pm 2\%$ from 10 mTorr-760Torr
- Accuracy (typical) $\pm 5\%$ from 3 mTorr-10 mTorr
- Calibration stability with temperature of the substrate $< 0.7\%/K$
- Leak rates \ll conventional methods 10-16 Torr.L/sec



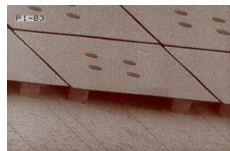


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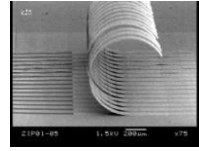
Examples of Achievements: Micromirrors and Louvers



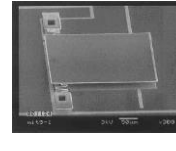
Flexure Hinge Mirrors



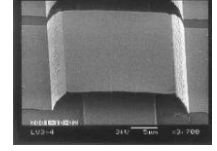
Piston-like Micromirrors



Zipping Actuators

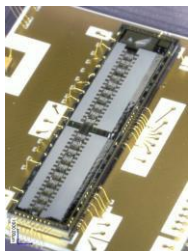


Large Deflection Angle Mirrors

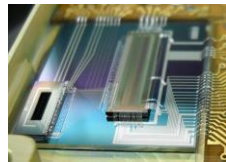


SLM Mirrors

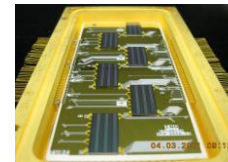
Heterogeneous Assembly: Multichip Structures



Inertial Measurement Unit (IMU) and its CMOS ROIC on a ceramic routing circuit



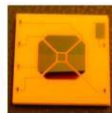
FPA and its CMOS ROIC on routing circuit (Si+ceramic)



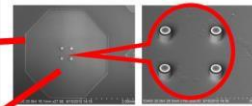
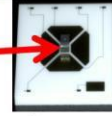
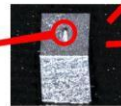
Staggered assembly of 6 IRL 512x3 bolometric FPA's (alignment tolerance better than 50 μm)

Heterogeneous Assembly: Building Blocks

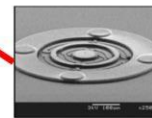
1. Substrate+ actuation electrodes (metallization patterning by lift-off)



2. Supporting post (fab: electroplating, DRIE, dicing; assembly: flip-chip bonding)



4. Mirror (fab: sputter deposition of reflective layer, electroplating, DRIE, dicing, release from wafer carrier; assembly: flip-chip bonding)



3. Gimbals spring (fab: electroplating; assembly: flip-chip bonding, release from wafer carrier)

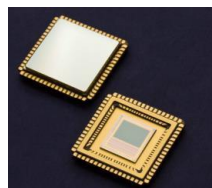
Gen4 Package

KEY APPLICATIONS

- The ceramic LCC vacuum packaging technology was developed for uncooled bolometric detectors.
- The package can also accommodate other MEMS devices that require a vacuum environment ≤ 1 mTorr

ADVANTAGES

- High productivity due to batch processing
- Low-cost
- Compact size
- Fluxless technology
- Compatible with temperature sensitive devices
- Flexibility in package geometry, window materials and solder alloys
- Integrated pressure sensors for cavity pressure monitoring



Gen5 Package

KEY APPLICATIONS

- High-end military and space applications

ADVANTAGES

- Hermeticity yield > 90% (in progress)
- Internal pressure < 5 mTorr
- Refireable getters
- Targeted lifetime of 25 years
- Scalable platform
- Unique pumping and pinching capability offering external services outside of USA

