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

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### 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

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### 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)

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### 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): ±1.5% of reading from 3 mTorr to 760 Torr
- Accuracy (typical) ±2% from 10 mTorr-760Torr
- Accuracy (typical) ±5% from 3 mTorr-10 mTorr
- Calibration stability with temperature of the substrate < 0.7%/K
- Leak rates << conventional methods 10-16 Torr L/sec
MEMS/MOEMS FOUNDRY SERVICES

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

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