

# Fully wafer-level integrated bias micromagnets for magnetic sensors

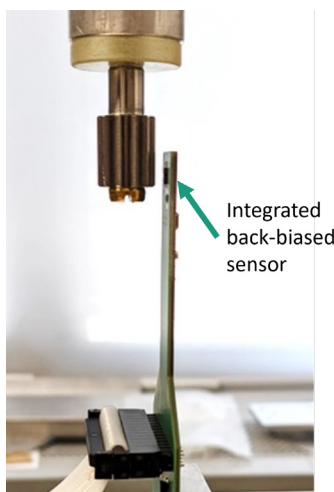
Various NdFeB micromagnets integrated in 8" / 200 mm Wafer.

Fraunhofer ISIT has developed a micromanufacturing technology to provide integrated micromagnets on wafer-level for biasing magnetic field sensors. The magnets are integrated into the substrate to achieve a high level of miniaturization and save wafer space. In- and out-of-plane bias fields can be created in custom distributions for Hall and XMR magnetic field sensors.

Utilizing this technology, Fraunhofer ISIT and IIS have realized a fully integrated 3D Hall sensor. The demonstrator combines the 3D HallInOne® Hall sensor technology from Fraunhofer IIS with the PowderMEMS technology of Fraunhofer ISIT<sup>1</sup>.

## Technology<sup>2</sup>

The bias magnets are fabricated by the proprietary PowderMEMS process developed by Fraunhofer ISIT. The technique allows for a precise integration of the magnets directly into the device wafer. Microfine magnetic powders are dry-filled into microcavities and solidified by low temperature ALD. The magnets are chemically resistant and thermally stable and can be created from a wide variety of magnetic materials.



Right: modulation of the magnetic field during rotation of the gear wheel.

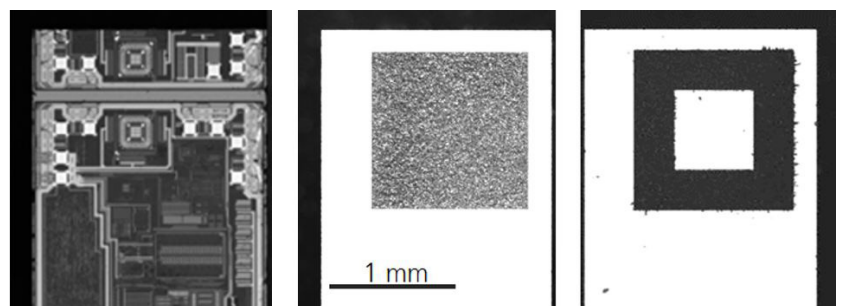
Left: Demonstrator setup with fully integrated biased Hall-sensor

## Examples of applications

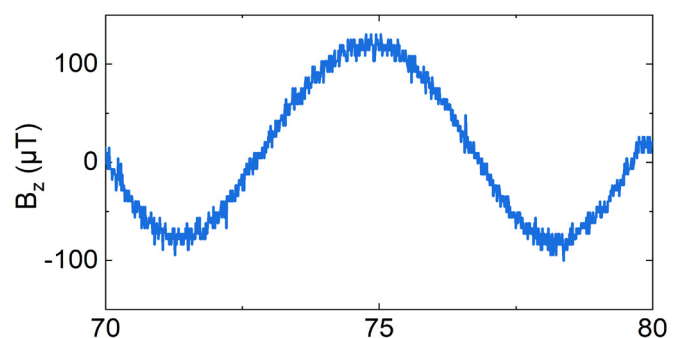
- Back-biased sensing of mechanical motion in confined spaces
- Integrated, miniaturized in plane biasing of AMR sensors
- Magnetic field sensing in weight and space confined applications
- Improvement of sensor performance with optimized magnetic field distributions

## Our services

- Development of wafer-level integrated micromagnets for magnetic field sensors
- Concept, design, manufacturing, and characterization
- Pilot production in 8"/200 mm MEMS fab and dedicated PowderMEMS facility



Chip with 3D Hall-sensor on the front side (left image) and wafer-level integrated NdFeB magnets of different shapes on the back side. Note that any custom geometry can be realized.



<sup>1</sup><https://doi.org/10.1109/MEMS49605.2023.10052184>

<sup>2</sup><http://doi.org/10.3390/mi13030398>



## Wafer-level integrated bias micro- magnets for magnetic sensors

### MEMS R&D at Fraunhofer ISIT

#### Professional MEMS production line

- Development and production: 8" / 200 mm wafer technologies (silicon and glass)
- Cleanroom area: 1400 m<sup>2</sup>
- Critical Dimension: 0.35 micron and below
- Installed capacity: 800 wafers per month in one shift
- Chemical-mechanical polishing (CMP) facility: 200 m<sup>2</sup>
- Wafer grinding and dicing facility: 100 m<sup>2</sup>

#### PowderMEMS R&D laboratory

- Dedicated atomic layer deposition (ALD) tool for 8" / 200 mm wafers
- Custom tooling for automated filling of wafers with dry powders
- Optical and magneto-optical inspection for characterization and quality control
- Custom tooling for magnetization of 8" / 200 mm wafers

### Contact

Florian Ziegler  
Agglomerated Microsystems  
+494821 17-1465  
florian.ziegler@isit.fraunhofer.de

#### Fraunhofer Institute for Silicon Technology ISIT

Fraunhoferstraße 1  
25524 Itzehoe, Germany  
www.isit.fraunhofer.de

ISIT is participant of



MEMS cleanroom at Fraunhofer ISIT  
Discover our cleanroom in a 360° tour: [s.fhg.de/isit360](https://s.fhg.de/isit360)

