

AMR current sensor with monolithic bias magnets

8" / 200 mm CMOS wafer
with integrated
PowderMEMS® micromagnets

Fraunhofer ISIT and Sensitec GmbH demonstrate an AMR current sensor with NdFeB permanent magnets integrated on wafer-level into the sensor substrate underneath the CMOS layers. The magnets are integrated into the finished CMOS wafer ("PowderMEMS®-Last"), enabled by the low temperature of the integration process. The ADK769 AMR sensors functions like the conventional, discrete version. The demonstrated approach

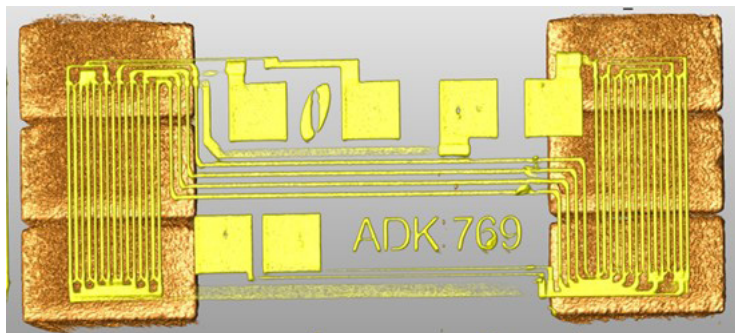
eliminates the need for discrete assembly of external bias magnets and allows for smaller packaging, thus reducing size and cost per device.

The PowderMEMS® approach can be applied to various kinds of microelectronic devices or MEMS, whenever local magnetic fields are required.

Applications

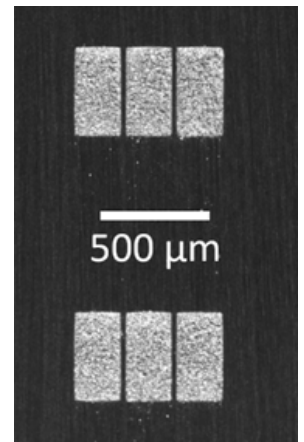
- Current sensing
- Magnetic field measurement

CT scan top-view of an
ADK769 AMR sensor die
and PowderMEMS®
integrated bias magnets



PowderMEMS® technology

PowderMEMS® is a unique process for the integration of NdFeB micromagnets and other ferrous and non-ferrous materials on wafer level. Dry loose powder is filled into microcavities in silicon or glass substrates. The powder is then fixed in place by atomic layer deposition (ALD) of a ceramic nanolayer that mechanically interconnects individual particles. Due to the low process temperature, PowderMEMS® is ideally suited for the modification of pre-processed CMOS wafers. PowderMEMS® wafers are safe to handle in clean-room environments and are compatible with most MEMS processes.



Optical image of NdFeB
PowderMEMS® magnets
in sensor substrate

Available materials	NdFeB, Ferrite, etc.
Process temperature	Below 100°C
Typ. Lateral magnet dimensions	30µm ... 4000µm
Typ. Vertical magnet dimensions	30µm ... 1000µm
Typ. remanence B_r (NdFeB)	Up to 550mT
Magnetization (3T) out-of-plane / in-plane	Complete 200mm wafer / Individual chips
Typ. Upper Temperature limit (NdFeB)	130°C
Typ. Lower Temperature limit (NdFeB)	Cryogenic conditions (~10K)

Properties of PowderMEMS® micromagnets

Our services:

- Customer-driven development of microelectronic devices and MEMS with monolithic permanent micromagnets
- Concept design, manufacturing, and characterization
- Pilot production in 8" / 200 mm MEMS fab and dedicated PowderMEMS® facility

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MEMS R&D at Fraunhofer ISIT

Professional MEMS production line

- Development and production: 8" / 200 mm wafer technologies (silicon and glass)
- Cleanroom area: 1400 m²
- Critical Dimension: 0.35 micron and below
- Installed capacity: 800 wafers per month in one shift
- Chemical-mechanical polishing (CMP) facility: 200 m²
- Wafer grinding and dicing facility: 100 m²

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

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<https://s.fhg.de/PowderMEMS-EN>



MEMS cleanroom at Fraunhofer ISIT
Discover our cleanroom in a 360° tour: s.fhg.de/isit360