

# PowderMEMS<sup>®</sup> Technology

**3D Microcomponents for Innovative Microsystems** 

MEMS energy harvesters with integrated micromagnets

PowderMEMS<sup>®</sup> - unique microfabrication possibilities

- 3D structures up to several hundreds of µm in thickness on wafer/ substrate-level
- Precise structural dimensions in between 30 μm and 4000 μm
- Numerous degrees of freedom, like magnetic, thermal and conductive properties, porosity and 3D-geometry
- Novel base technology for sensors, actuators, coils, transformers, cooling, filters etc.
- Advantages compared to other manufacturing techniques: low process temperatures, thermally and chemically resistant structures, BEOL-compatible pre- and post-processing, wide choice of materials

### PowderMEMS® Technology

Fraunhofer ISIT has developed a patented process to createthreedimensional microstructures from a multitude of materials on wafer-level. The technology enables the integration of micromagnets, thermal insulation, microfl uidic channels and numerous other features for next-generation microsystems. PowderMEMS access the third dimension on wafer-level for the design of microsystems with decisive advantages compared to other techniques like sintering or polymeric binding. Various parameters can be taken advantage of, such as the choice of powder material, the creation of three-dimensional shapes and the ability to preand post-process with established clean room techniques.

### **Examples of Application**

- Magnetic MEMS, e.g.magnetic field sensors, energy harvesters, quantum devices
- Microfluidics, e.g. microreactors and catalysis
- Microelectronics, e.g. integrated microcoils for DC/DC converters

### **Technical Specifications**

Structure lateral dimensions	30 µm to 4000 µm
Structure thickness	30 µm to 1000 µm
Applicable materials	as required: metals,
	ceramics, composites
Hard and soft magnetic properties	example NdFeB:
e.g. NdFeB, SmCo, Fe	$B_{\rm R} \approx 550  {\rm mT}$ ,
	H <sub>c</sub> ≈ 770 kA/m
Process temperature	75°C to 300 °C
Clean room compatible post-processing	yes
Porous structures / microfluidics	yes



200 mm Si Wafer with integrated NdFeB micromagnets



Cross section of a porous microfluidic structure



CT scan of an AMR sensor with substrate-integrated PowderMEMS® biasing magnets

ISIT is a participant of





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