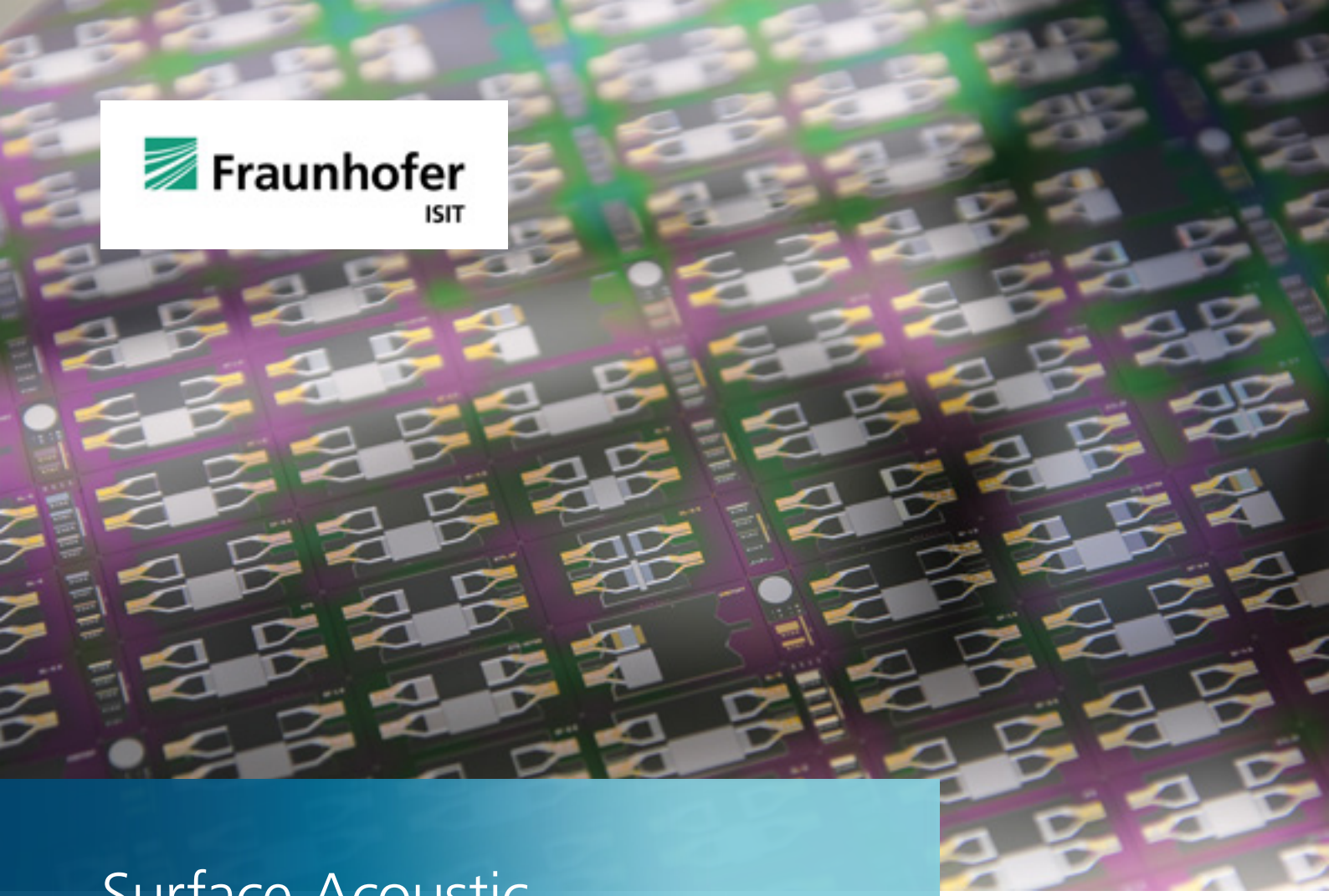

Surface Acoustic Wave Sensors

Variety of SAW magnetic field sensors on an 8-inch Si wafer.

Motivation

Fraunhofer ISIT develops sensors based on the modulation of surface acoustic waves (SAW). This technology forms a sensor platform at ISIT in which various mechanisms can be utilized to measure different physical phenomena. In addition to mass absorption, elastic, viscoelastic or electrical effects can be exploited. Dedicated functional coatings enable a wide range of applications comprising pressure, humidity, electric field, vibration, gas, bio or magnetic field sensors.

A special feature common to all SAW sensors is that they are suitable for measuring both static and rapidly changing states.

Based on the SAW-technology platform, ISIT is currently developing a high-performance current sensor with a dynamic range of 8 orders of magnitude and a bandwidth in the MHz range in cooperation with the Christian-Albrechts-Universität zu Kiel and the Fraunhofer Institute for Applied Solid State Physics.

This sensor is designed to precisely measure the very fast switching processes (~kA/ns) of modern switch-mode power supplies and thus enable highly efficient power conversion. The functional layer of this sensor consists of a magnetostrictive layer that causes a field-dependent modulation of the SAW wave by changing the elastic modulus.

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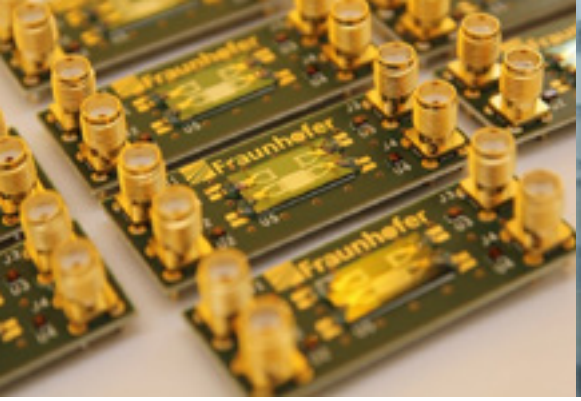
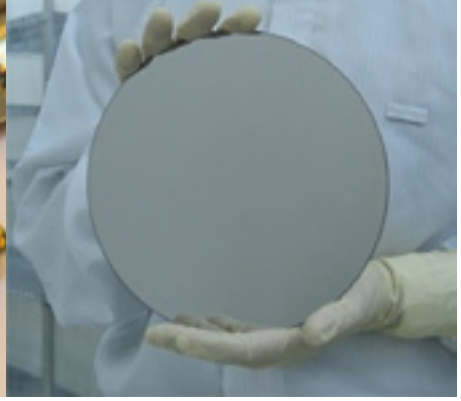
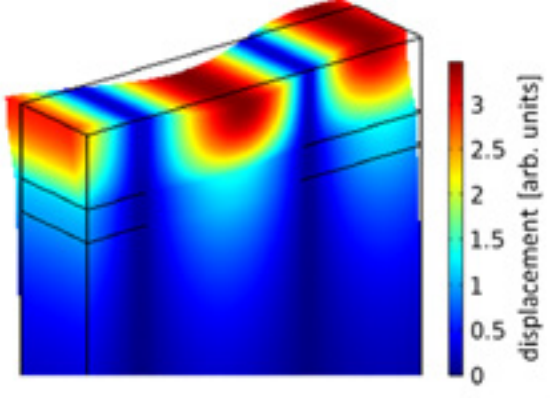


Test PCB with SAW magnetic field sensor



8-inch wafer with AlScN



Propagation behavior of the acoustic wave within the guilding layer

Technology

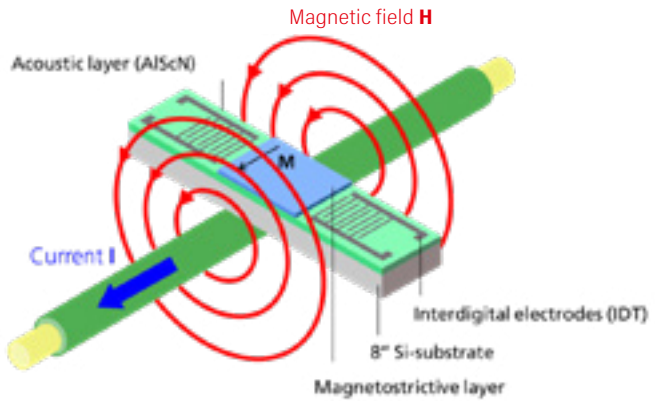
The distinctive aspect of the SAW sensor technology at ISIT is that it does not rely on volume crystals such as quartz. Instead, ISIT's SAW sensor elements are entirely fabricated in CMOS- and MEMS-compatible silicon technology. This is only made possible by the use of the high-performance piezoelectric thin-film material AlScN.

In addition to the high technology compatibility, further advantages are higher process flexibility with regard to the integration of functional layers, a reduced chip size as well as the possibility to fuse different sensors on one chip.

Applications

Magnetic field sensor for

- Efficient energy conversion for electro mobility, renewable energies and lighting
- Data centre monitoring
- Feedback and control for home, motors and industry



Operation principle of SAW sensor

Publications

Meyer, J. M., Schnell, V. et al. Thin-film-based SAW magnetic field. Sensors, 2021, 21. Jg., Nr. 24, S. 8166.

Moench, S., Meyer, J. M. et al. AlScN-Based SAW Magnetic Field Sensor for Isolated Closed-Loop Hysteretic Current Control of Switched-Mode Power Converters. IEEE Sensors Letters, 2022, 6.Jg., Nr. 10, S. 1-4.

Technical Data

Magnetic field sensor with

- Bandwidth of up to 10 MHz
- DC capable
- Contactless measurement
- Chip size < 1 mm²
- Measuring range from µA to kA
- Compatible with CMOS and MEMS technology
- 8'' technology

Handling of 8-inch wafer in clean room

Our service

- Consultancy and concept study
- MEMS Design and feasability
- Fabrication of prototypes
- Patent-protected technologies
- Partnership for future developments
- Application demonstrators