

1 Variety of piezoelectric MEMS devices for acoustic applications on an 8-inch wafer.

ACOUSTIC SYSTEMS AND MICRO ACTUATORS

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The group Acoustic Systems and Micro Actuators at Fraunhofer ISIT combines the expertise of micro actuator concepts and their fabrication with the fast developing field of MEMS acoustics. Applications range from audible acoustics for consumer applications over airborne as well as liquid-borne ultrasound up to structure-borne sound for technical applications. Acoustic MEMS devices cover both, the generation of sound (loudspeaker) as well as its detection and measurement (microphone).

Revolution in headphone speakers

Our reference system is a MEMS micro-speaker based on piezoelectric bending actuators for use in headphone applications. With an area of only 4 mm x 4 mm the MEMS microspeaker enables sound pressure levels of more than 110 dB measured in a 2 ccm ear simulator with a flat frequency response

Benefits of MEMS Acoustics

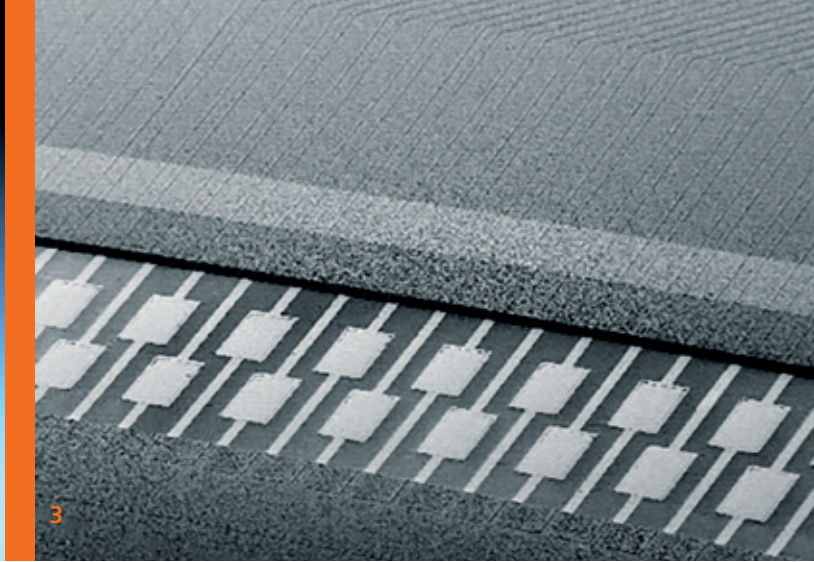
- High miniaturization yielding smallest sizes
- Excellent integratability to microelectronics
- Highest energy efficiency
- High-volume, low-cost manufacturability using silicon technology

over a broad range from 20 Hz to 20 kHz. The high energy efficiency and low distortions make it the ideal microspeaker for truly wireless high-fidelity in-ear headphones and wearables.

Wide range of technologies

To achieve the best results and tailor the systems to the target applications, we have numerous complementary

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is participant of the



technologies at our disposal. The utilized concepts include but are not limited to magnetic, electrostatic and piezoelectric interaction. The fundamental effects are implemented in a variety of geometries to be utilized for high performance micro actuators.

Specialist in piezoMEMS

A special focus with more than 10 years of experience lies in the utilization and integration of piezoelectric materials. Our piezoMEMS technology platform today comprises the functional materials lead zirconate titanate (PZT), aluminum nitride (AlN) as well as aluminum scandium nitride (AlScN). A typical implementation is the use in unimorph structures, where the piezoelectric material works against a passive second layer to induce bending.

What we offer

At ISIT we offer the full development chain for acoustic MEMS and micro actuators. Starting from the concept phase we use our broad system know-how and numerical simulations to find the optimal design of the MEMS device for the application requirements together with its integration into the system. The fabrication process is developed using our 200 mm silicon technology in-house capabilities complying with industry standards, together with assembly for extensive characterization and testing of the produced prototypes. The developed process and facilities can subsequently be used for pilot fabrication or transferred to a high-volume manufacturer.

- 2** MEMS microspeaker in an in-ear headphone prototype.
- 3** SEM image of a PZT based ultrasonic transducer array.
- 4** FEM simulation of a MEMS in-ear speaker coupled to an ear simulator.

Our Service

- Expertise and IP in the field of micro actuators and MEMS acoustics
- Full development chain for MEMS devices and systems: concept, design, simulation, fabrication, assembly, characterization and testing
- Pilot fabrication of MEMS
- Partnership for future developments in the field of MEMS acoustics and micro actuators

