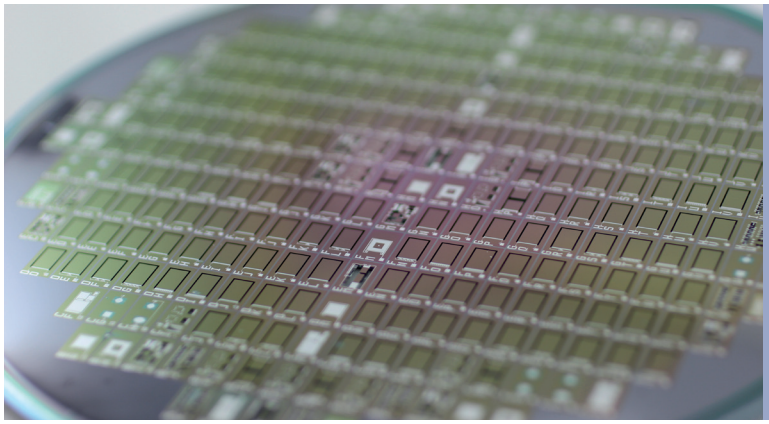
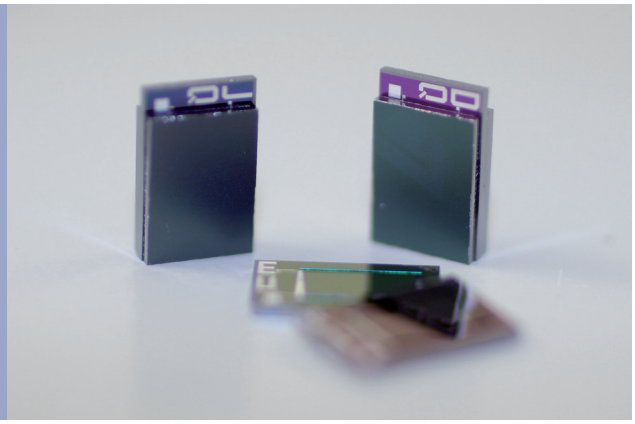
ALUMINUM NITRIDE

SMART INTEGRATION OF THIN FILM PIEZOELECTRICS IN MEMS/NEMS





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Aluminum nitride (AlN) is a seminal material for MEMS and NEMS sensors and actuators. The energy density for piezoelectric working principles is much higher compared to capacitive MEMS driving and sensing principles. This allows the shrinking of MEMS and NEMS, which reduces costs and energy consumption and increases the areas of application. Thereby, piezoelectric driven MEMS (piezoMEMS) could be an alternative for actuators with smaller feature sizes. Furthermore, AlN is highly capable of being integrated into micromechanical and CMOS processes. In contrast to the commonly used PZT, no high temperature powder sintering processes and no patterning with the formation of toxic byproducts are necessary for AlN as piezoelectric material. Rather deposition and patterning of AlN can be realized in conventional equipment for aluminum based back-end of line technologies. This enables the common fabrication of piezoMEMS and CMOS devices in the same production line. The Fraunhofer ENAS and the Center for Microtechnologies of the Technische Universität Chemnitz developed the technology to sputter and characterize piezoelectric thin film AlN and integrates this material in silicon based MEMS and NEMS applications. This includes as well the development of patterning processes with adequate geometry and selectivity to subjacent materials. For a reliable production of piezoMEMS a precise characterization of the piezoelectric coefficients is essential. Piezoelectric thin film characterization requires a high specialization and know-how in measurement and analysis. At the Fraunhofer ENAS and the Center for Microtechnologies unique characterization methods to analyze the piezoelectric coefficients are established.

AlN

- Green and Lead-free technology
- CMOS compatible technology
- Intrinsic energy generation
- High energy density
- High coupling factor
- Sensor and actuator material
- Out-of-plane detection and driving
- Ultra-low-power applications
- Energy harvesters

Piezoelectric thin film charaterization

- Laser-Doppler-Measurement tools
- Analyzing of AlN, PZT or other material
- Unique analysis tools for d_{33} and d_{31}

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