

# Lead-Free Piezoelectric Materials

Innovative materials and processes to transition piezoelectric devices to tomorrow's lead-free world

## What it is

The European RoHS Directive now outlaws lead in all new electronics released on the market. PZT, a common piezoelectric material containing lead, is exempt, but the clock is ticking. CEA-Leti possesses deep knowledge of two lead-free piezoelectric materials: KNN (potassium sodium niobate) and AlScN (aluminum scandium nitride).

CEA-Leti's expertise covers the entire value chain, from selecting the appropriate material and fine-tuning dopant concentrations for specific applications to integrating the materials into devices, accelerating the transition to lead-free electronics.

## What it can do

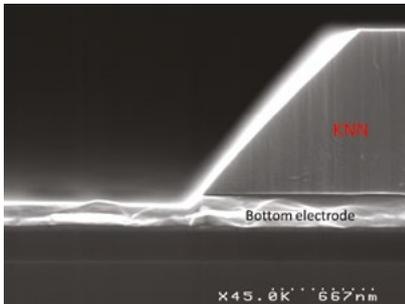
CEA-Leti can integrate lead-free materials into a variety of devices:

- Piezoelectric MEMS micro-speakers and microphones,
- Piezoelectric micromachined ultrasonic transducers (PMUTs) for consumer, automotive, and medical sensors,
- MEMS for optical devices like lenses and micro-mirrors.

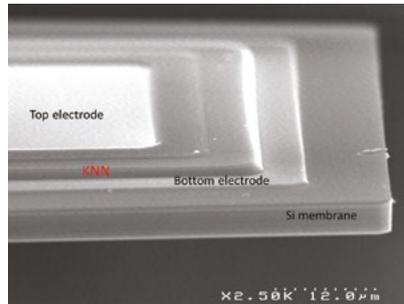
## What makes it unique

CEA-Leti's in-depth knowledge of these lead-free piezoelectric materials, combined with industrial-scale fabrication processes, is unique. CEA-Leti's piezoMEMS processes are compatible with 200 mm VLSI technologies for direct transfer to commercial fabs.

200 mm KNN wafers from Sumitomo Chemical can be fully processed in-house in CEA-Leti cleanrooms. CEA-Leti is currently optimizing its in-house AlScN deposition process and will soon possess its own KNN deposition capabilities, broadening the range of devices that can be fabricated at CEA-Leti.



▲ SEM photograph of a thin KNN layer after etching



▲ SEM image of the free end of a MEMS micro-cantilever beam integrating a KNN layer

## Working with CEA-Leti

CEA-Leti has a strong track record transferring PZT processes to major foundries. These same capabilities are now available for lead-free piezoelectric materials. Semiconductor foundries, fabless companies, semiconductor process equipment manufacturers, and tech companies can turn to CEA-Leti to develop the next generation of lead-free devices for their own products and their integrator customers.

CEA-Leti is accustomed to working with third-party KNN suppliers and is prepared to scale-up lead-free-material deposition processes to meet new partners' specific needs.

## At a glance

- 20+ years of experience with piezoMEMS
- In house expertise with lead-free piezo materials backed by numerous scientific publications
- 3 transfers of piezoMEMS processes to foundries

## Scientific publications

- Kuentz, H., et al. (2024). "KNN lead-free technology on 200 mm Si wafer for piezoelectric actuator applications." *Sensors and Actuators A. Physical*, 372, 115370.
- Mollard, L., et al. (2025). "Effects of potassium sodium niobate (KNN) thickness on biaxial non-resonant microelectromechanical systems (MEMS) mirror performance." *J. Sens. Sens. Syst.*, 14, 27–35.

## Interested in this technology?

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