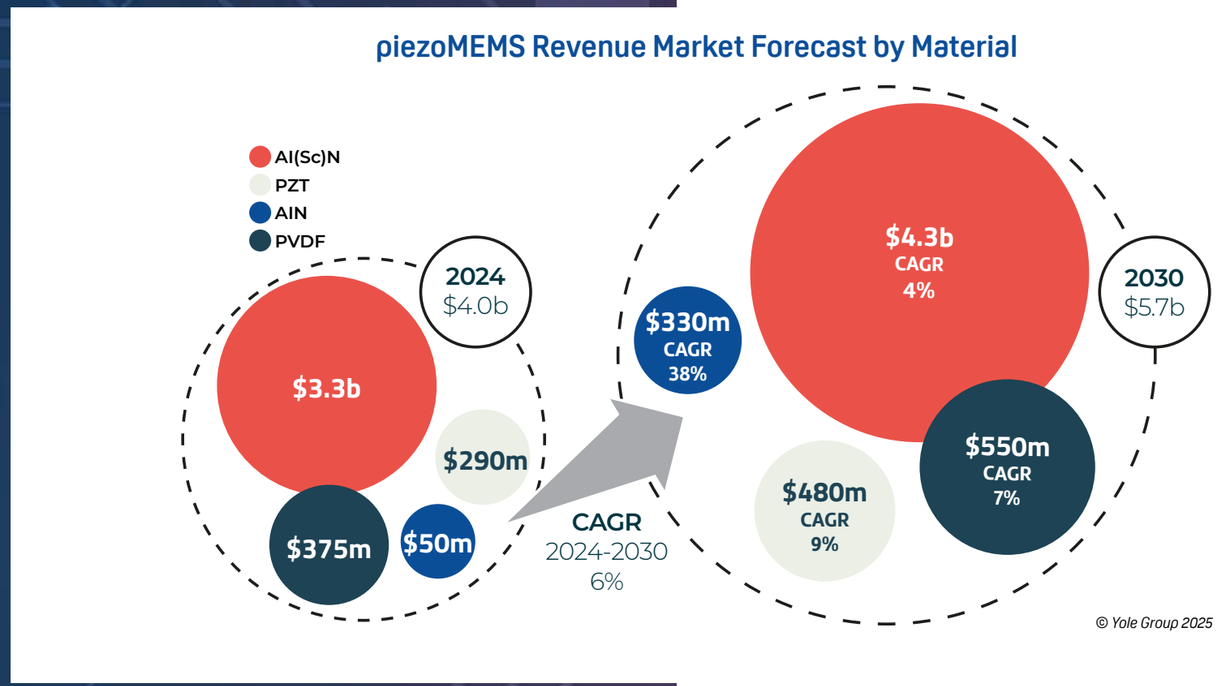


The rise of piezoMEMS:

Vibrant opportunities and challenges

After a wide adoption in RF filters, piezoMEMS are powering the next generation of microspeakers, oscillators, optical switches, and microcooling devices.

Piezoelectricity is a physical phenomenon that has been utilized for nearly a century. Thin film deposited materials, such as PZT, AlN (with or without Sc doping), KNN, $LiNbO_3$, and PVDF, are now being widely applied across various industries. Depending on the application, piezoelectric-based components can be used for sensing, actuation, or signal transduction (physical to electrical or vice versa). The piezoMEMS device market was valued at $4 billion in 2024 and is projected to grow to $5.7 billion by 2030, at a 6% $CAGR_{24-30}$.

Today's snapshot is based on the sensing collection of reports offered by Yole Group. This collection includes the annual report, Status of the MEMS Industry 2025, as well as PiezoMEMS Technologies 2025, Microphones, Microspeakers and Audio Processing 2025, Sensors and Actuators for Wearables 2025, Greater China MEMS Industry 2025, PiezoMEMS Comparison 2025.

MEMS devices based on piezoelectric materials are primarily used in applications such as RF filters, inkjet printheads, microphones, voice accelerometers, microspeakers, micromirrors, timing oscillators, ultrasonic fingerprint sensors, and ultrasonic pMUTs (used in imaging, radar, cameras, and Time-of-Flight systems). Among these various devices, significant advancements are expected in MEMS microspeaker technology.

In contrast to the well-established MEMS microphone market, which reached nearly seven billion units in 2024, the MEMS microspeaker market is still in its early stages of adoption, with two million units sold in 2024. MEMS microspeakers compete with well-established legacy technologies such as electrodynamic speakers (ES) and balanced armature (BA) speakers.

With the ability to be integrated in TWS earbuds, Smart Glasses, AR headsets, and Smartwatches, MEMS microspeakers offer several advantages over traditional technologies. These include lower power consumption, high repeatability and uniformity, greater assembly reliability, immunity to dust and water, and the potential for a lower average selling price (ASP) through economies of scale. The MEMS microspeaker market was worth $3.9 million in 2024, representing approximately two million units, and is expected to grow at a 79.8% $CAGR_{24-30}$.

Companies such as xMEMS, USound, and AAC Technologies are leading players in the MEMS microspeaker market, with xMEMS and USound together accounting for 93% of the market. Both companies use piezoelectric PZT thin-film layers in their product designs for actuation purposes. This PZT layer is typically deposited using the physical vapor deposition method (USound – Conamara) or the sol-gel spin-coating method (xMEMS – Montara, Cowell; USound – Achelous). (A detailed analysis of these devices can be found in our comparison report, PiezoMEMS comparison 2025). While xMEMS and USound already have products available on the market, several other companies are actively developing their solutions, aiming for market entry in the coming years, including Bosch Sensortec, Sonic Edge, MyVoX, and Fortémedia.

About the Author

Clyde Midelet, PhD, is Senior Technology & Market Analyst at Yole Group.

Working within the Sensing, Imaging, and Display activity, Clyde contributes daily to technology and market analyses as well as the development of relevant products. He is also involved in custom consulting projects at Yole Group. His expertise spans various areas, including microfluidics, sensing, and MedTech.

After completing his master's in solid-state chemistry at Rennes University in France, Clyde pursued a PhD at the École Normale Supérieure de Rennes in collaboration with the SATIE laboratory in France.

During his research in microfluidics, which resulted in various scientific papers, Clyde developed a system for the electrical manipulation of gold nanoparticles for biosensing in in-vitro diagnostics. Additionally, he worked on an industrial project related to next-generation displays using quantum dot technology.

Characteristics	U SOUND	MEMS		BOSCH	SONIC EDGE
Technology	Piezo actuator with plastic membrane	Piezo membrane	Modulated ultrasound	Electrostatic membrane	Modulated ultrasound
Sensitivity to vibration	Medium	Medium	None	Medium	None
PCB assembly possibility	YES	YES	YES	YES	YES
Bass audio quality	N/A. 2 ways audio system used: 1 MEMS for tweeter + 1 legacy for the woofer	N/A	Possible	N/A	Possible
Mid audio quality	YES	YES	YES	YES	YES
Treble audio quality	20 kHz	40 kHz	40 kHz	20 kHz	40 kHz
HD audio	NO	NO	YES	NO	YES

This table shows that ultrasound modulation technology brings several advantages
©Yole Group 2025

One of the key challenges for MEMS microspeakers is achieving full-range audio performance across the entire frequency spectrum. The most promising approach to address this challenge is modulated ultrasound (a technology being explored by Sonic Edge and, more recently, xMEMS). Another viable solution for achieving high sound quality is a 2-way speaker system, where a MEMS device is used as a tweeter, paired with a legacy woofer. This is the approach adopted by USound.

While piezoelectric materials show strong promise in MEMS microspeakers, this represents just the tip of the iceberg in terms of broader application opportunities. Piezoelectric technologies are also of interest in several other sectors:

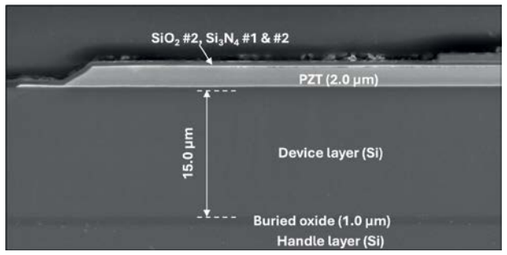
→ **Telecom:**
Future innovations such as 6G networks and Wi-Fi 8 will require new filter technologies, including XBAR (Murata) and XBAW (Akoustis*), both based on piezoelectric effects.

→ **AI & Data Infrastructure:**
- Development of high-precision timing solutions for data centers (e.g., SiTime)
- Deployment of optical switches (e.g. micromirrors) to reduce power consumption and increase bandwidth (e.g., Google, nEye)
- Emerging microcooling solutions to support high-performance computing in data centers and consumer devices (e.g. xMEMS, MyVox).

An entire ecosystem is emerging around piezoMEMS technologies. Foundries are advancing their expertise in piezoelectric thin-film deposition to better address the challenges of this growing market. They are now mastering deposition quality, increasing production capacity to meet market demand, and proactively addressing future challenges such as material restrictions related to lead content by offering alternative, lead-free solutions.

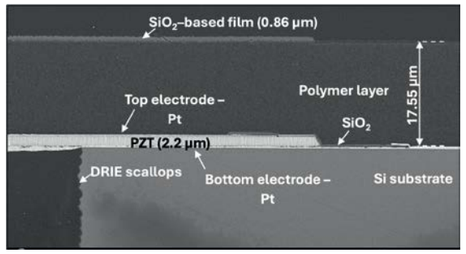
The latest report from Yole Group, "PiezoMEMS Technologies 2025", provides detailed insights into the market and technology trends that are poised to offer promising opportunities for the PiezoMEMS industry. This analysis is part of a collection of reports on sensing topic offered by Yole Group.

Achelous from USOUND



MEMS Membrane Cross-Section – SEM View
©Yole Group 2025

Conomara from USOUND



MEMS Membrane Cross-Section – SEM View
©Yole Group 2025

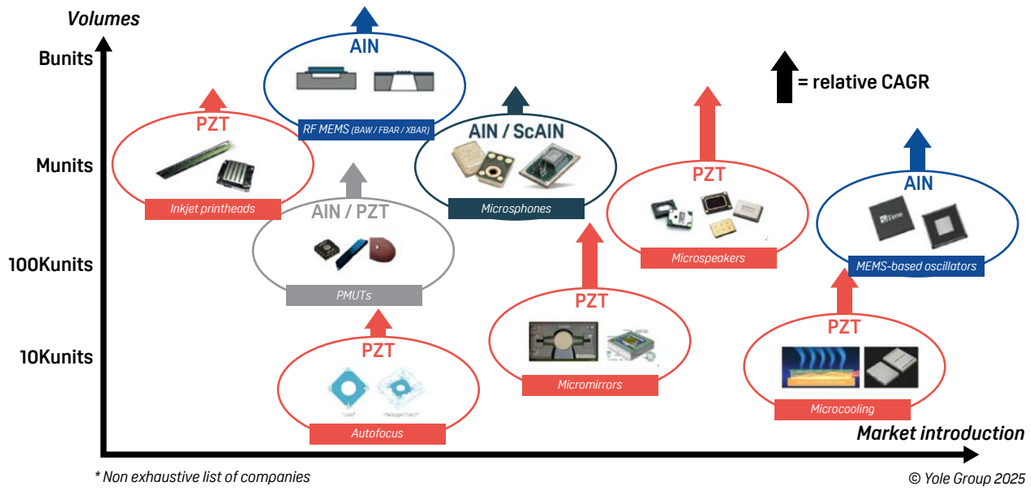
Related Yole Group's products
- *Status of the MEMS Industry 2025*
- *PiezoMEMS Technologies 2025*
- *Microphones, Microspeakers and Audio Processing 2025*
- *Sensors and Actuators for Wearables 2025*
- *Greater China MEMS Industry 2025*
- *PiezoMEMS Comparison 2025*

** Acquired by SpaceX*

Source: www.yolegroup.com

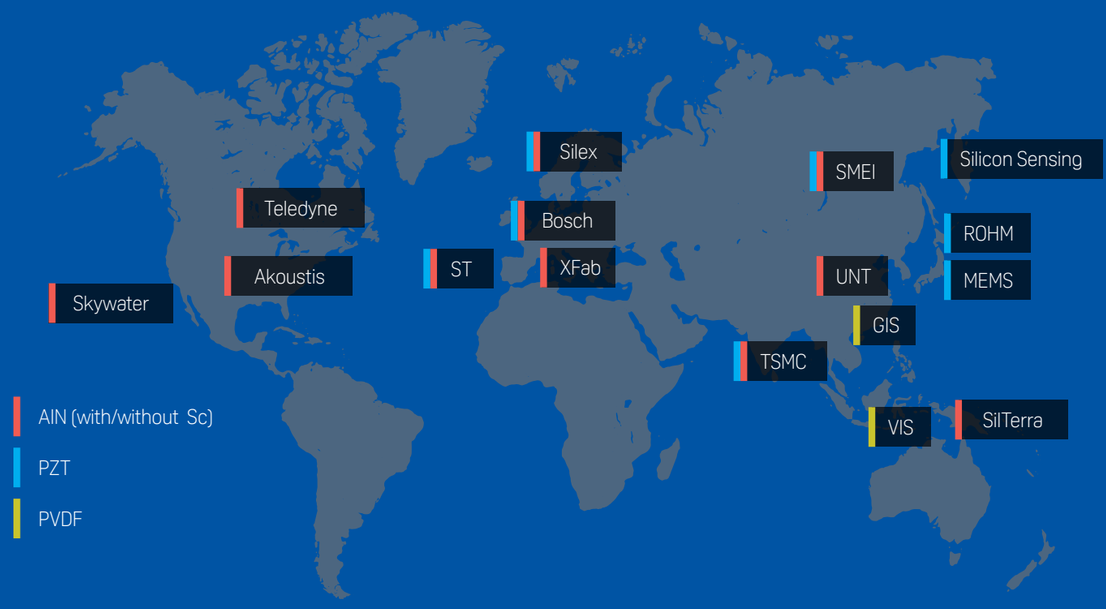
piezoMEMS Popularity

Increase of the use of PZT, AIN and ScAIN materials*



** Non exhaustive list of companies*
© Yole Group 2025

MEMS foundries with thin-film piezoelectric capabilities*



** Non exhaustive list of companies*
© Yole Group 2025