

Vibration-Resistant Microphone Based on ALTP

Sound creates a traveling wave leading to variations in pressure and density. In a typical microphone, this pressure wave is converted to an electrical signal by means of a vibrating membrane. In contrast, this invention uses an atomic-layer thermopile (ALTP) to detect the characteristic thermal fluctuations that are also part of the sound wave. This gives it several inherent advantages over classical microphones.



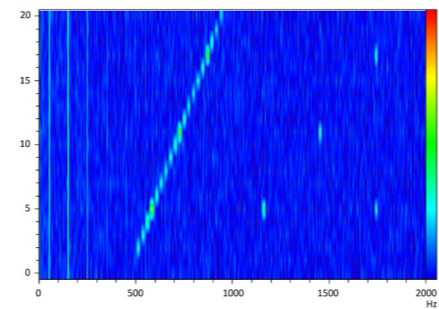
Recording sound in the form of fluctuations in temperature

A chief advantage of measuring sound as temperature fluctuations is its insensitivity to mechanical shocks and accelerations, making it especially suited for environments where sound and movements occur together. Another advantage is the broad acoustic frequency spectrum that can be captured, extending well into the ultrasound of several MHz.

- 01 Separate sound from vibrations when diagnosing a running motor or a gas turbine.
- 02 Chart the acoustic emissions of the air conditioning and other sources in a moving vehicle.
- 03 Use in a wind tunnel or other windy environment without the need for bulky shielding.
- 04 Avoid the risk of eigenfrequent resonances of the membrane of a classical microphone.



Front and perspective view of an ALTP. The side length of the central sensor element is ca. 1 mm, while the outer column measures ca. 8 mm across.



To verify that acoustic measurements based on temperature are possible in practice, the above ALTP was placed inside a Kundt's tube, where it produced this frequency spectrum of a sinus sweep from 500 Hz to 1000 Hz.

IP RIGHTS
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2024

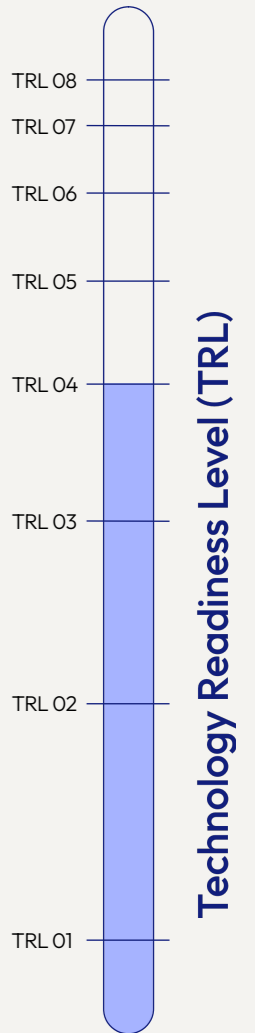
CHALLENGE

In most microphones, the pressure fluctuations constituting sound are picked up by a membrane, causing it to vibrate mechanically. These vibrations are then converted to an electric signal by one out of several possible mechanisms. This in turn means that acceleration or non-acoustic vibrations of the membrane, caused e.g. by wind or a moving frame of reference, will degrade the recorded signal. If the eigenfrequency of the membrane is excited, any useful signal may even be drowned out entirely.

INNOVATION

In the present invention, the substrate of an atomic layer thermopile (ALTP) sensor element is kept at a temperature somewhat above that of the surrounding medium. When an acoustic wave strikes the sensor, the temperature on the exposed side changes slightly, affecting the heat flow through the sensor element, thereby creating a voltage fluctuation due to the transverse Seebeck effect. This unique operating principle renders the ALTP sensor resistant to acceleration, making it immune to structure-borne vibrations or frequency excitations that adversely affect the membrane of a classical microphone.

01 Basic principles observed · 02 Technology concept formulated · 03 Experimental proof of concept · 04 Technology validated in lab · 05 Technology validated in relevant environment · 06 Technology demonstrated in relevant environment · 07 System prototype demonstrated in operational environment · 08 System complete and qualified



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