

Leveraging Semiconductor Eco-systems to MEMS

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SUMMARY

Taiwan, with a population of nearly 23 million and an area of 36,000 km², is highly active in the semiconductor industry and research, particularly in Hsinchu City where National Tsing Hua University (NTHU) is located. The faculty and students at NTHU frequently and closely interact with the semiconductor industry. This talk shares the experience of the speaker's group at the NTHU in leveraging Taiwan's extensive semiconductor eco-system (Fig. 1) to advance MEMS technologies through four stages:

1. Using CMOS-MEMS technology for inertial sensors as a bridge to connect with the semiconductor industry. (Fig. 2)
2. Addressing various mechanical challenges in thin films to show promising CMOS-MEMS environment sensing applications. (Fig. 3)
3. Demonstrating the benefits of MEMS-on-CMOS technology within foundries, highlighting the successful collaborations between MEMS and semiconductor technologies.

4. Exploring new functional materials for MEMS driven by potential applications in Smart-X and the Metaverse, as semiconductor industries develop new processes. (Fig. 4)

In conclusions, it is a win-win strategy between academia/research and industry/market to leverage the resources in mature semiconductor ecosystems for the development and commercialization of MEMS.

REFERENCES

- [1] W. Fang, et. al, "Smart Materials, Smarter Devices: Piezoelectric Thin Films in MEMS Applications," MEF 2026, Tokyo, Japan, April 2026.
- [2] W. Fang, et. al, "Leveraging semiconductor ecosystems to MEMS," IEEE MEMS 2023, Munich, Germany, January 2023.
- [3] YC Lee, et. al, "CMOS-MEMS technologies for the applications of environment sensors and environment sensing hubs," JMM, 2021.
- [4] SK Yeh, et. al., "CMOS-based tactile force sensor: a review," IEEE Sensors Journal, 2021.
- [5] W. Fang, et. al, "CMOS MEMS: A key technology towards the "More than Moore" era," Transducers 2013, Barcelona, Spain, June 2013.

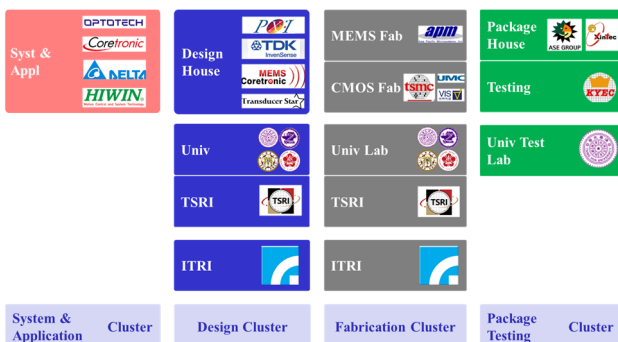


Fig. 1. MEMS/semiconductor ecosystems in Taiwan networking with NTHU: examples to showcase "Leveraging semiconductor ecosystems to MEMS"

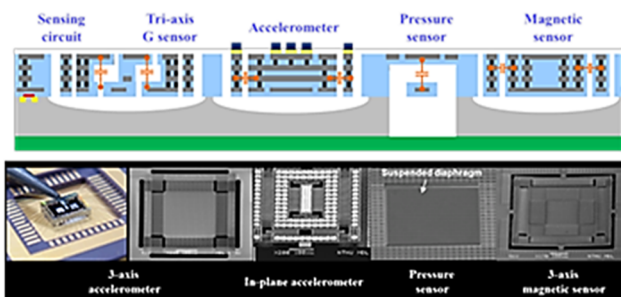


Fig. 2. The CMOS-MEMS inertial sensors platform

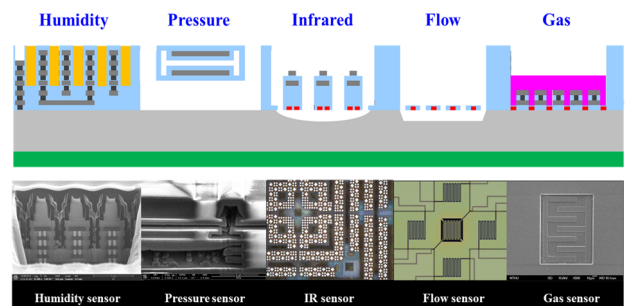


Fig. 3. The CMOS-MEMS environment sensors platform

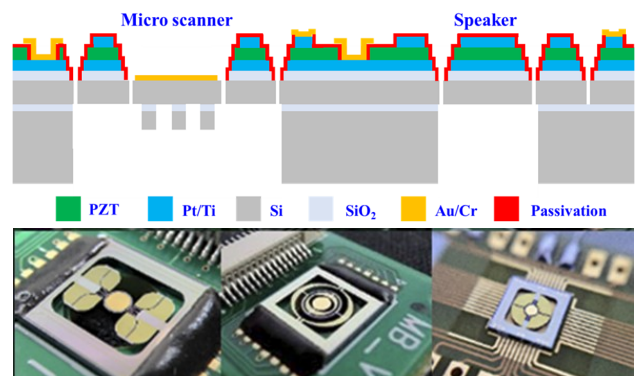


Fig. 4. The foundry available piezoelectric actuator platform, with optical scanners as an example.