

MEMS (Micro-Electro-Mechanical Systems) are miniaturized sensors and actuators that combine micro-mechanical parts with electrical components.

MEMS applications

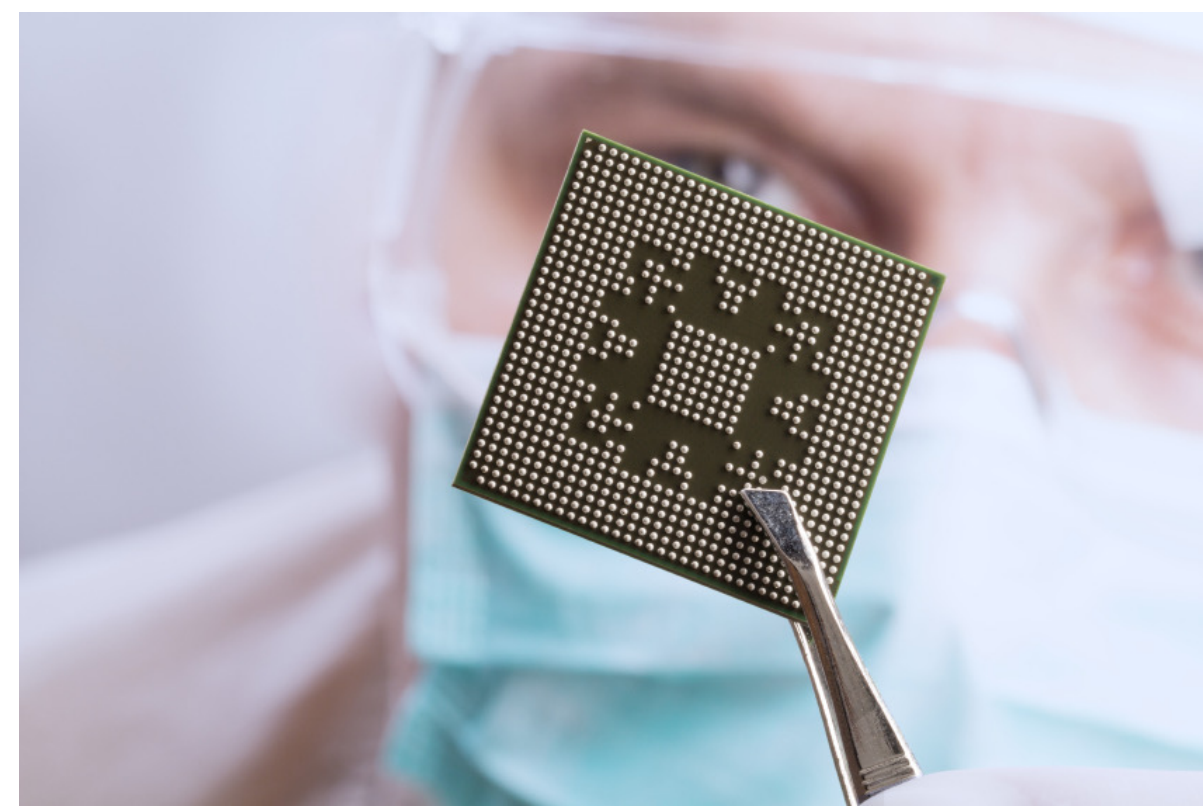
MEMS can be found in a wide range of systems comprising **automotive**, **medical**, **electronics**, **communication** or **defense applications**.



MEMS in automotive vehicles are **accelerometers** for airbag deployment, **gyroscopes** for Electronic Stability Control, **pressure sensors** for oil, tires, etc.



Accelerometers, **gyroscopes**, **microphones**, and **RF-filters** are some examples of MEMS sensors installed in every smartphones.



MEMS are important components of **lab-on-chip** devices for fast and disposable medical diagnostic.



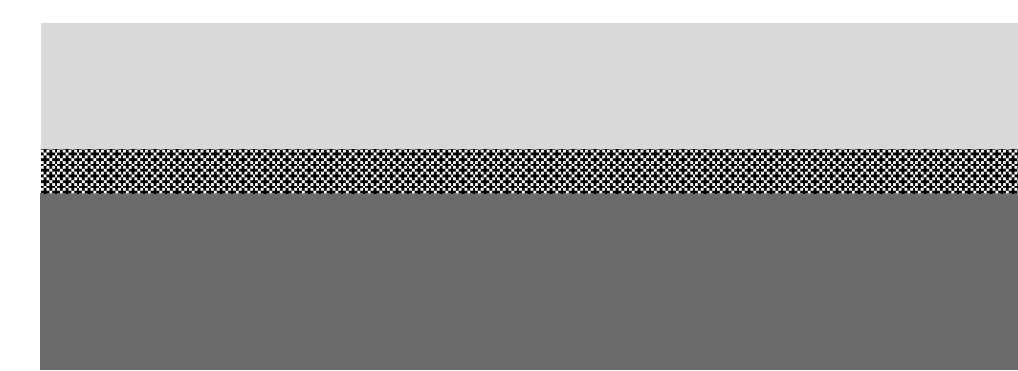
Displays for augmented reality rely on **MEMS micro-mirrors** for obtaining a large display area from a small light source.

MEMS process

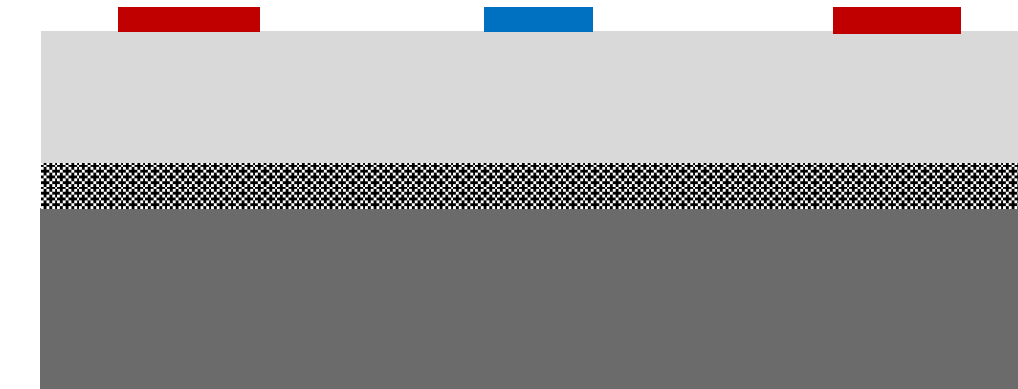
Within the frame of the European project OXiNEMS and the Joint Research Center with STMicroelectronics, two MEMS processes have been developed to integrate **functional materials** (magnetic, piezoelectric, etc.) **with MEMS**.

SOI process

1. SOI wafer



2. Material deposition



3. Reactive-ion etching



4. Wet release in HF

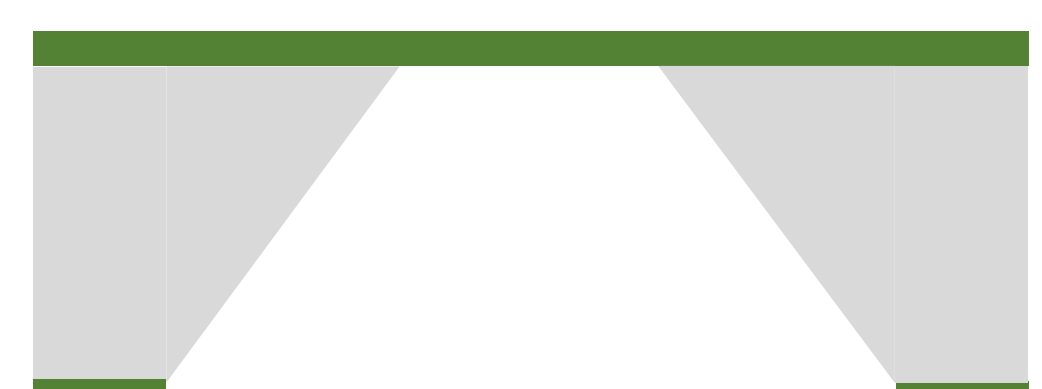


SiN process

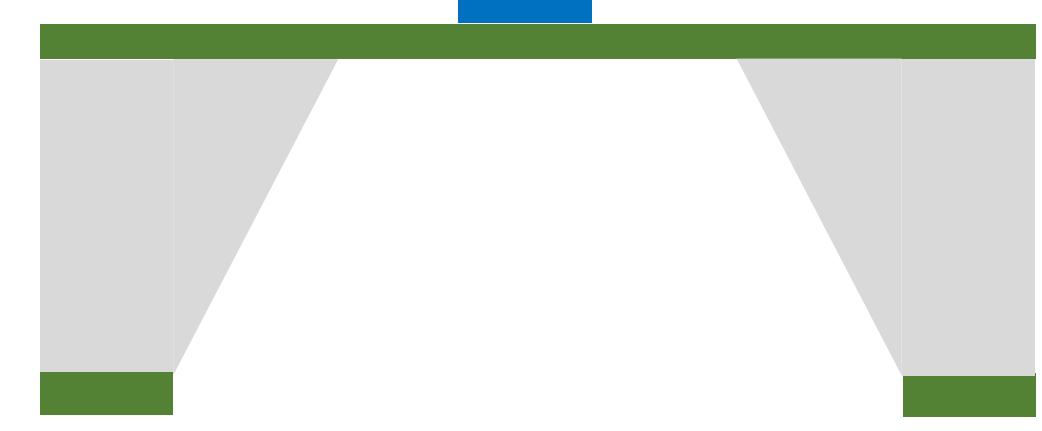
1. SiN/Si/SiN wafer



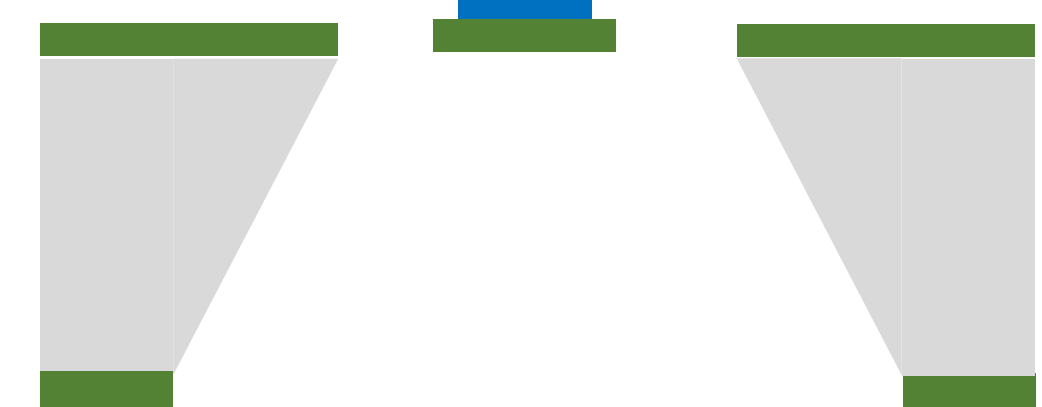
2. Backside wet etch in KOH



3. Material deposition

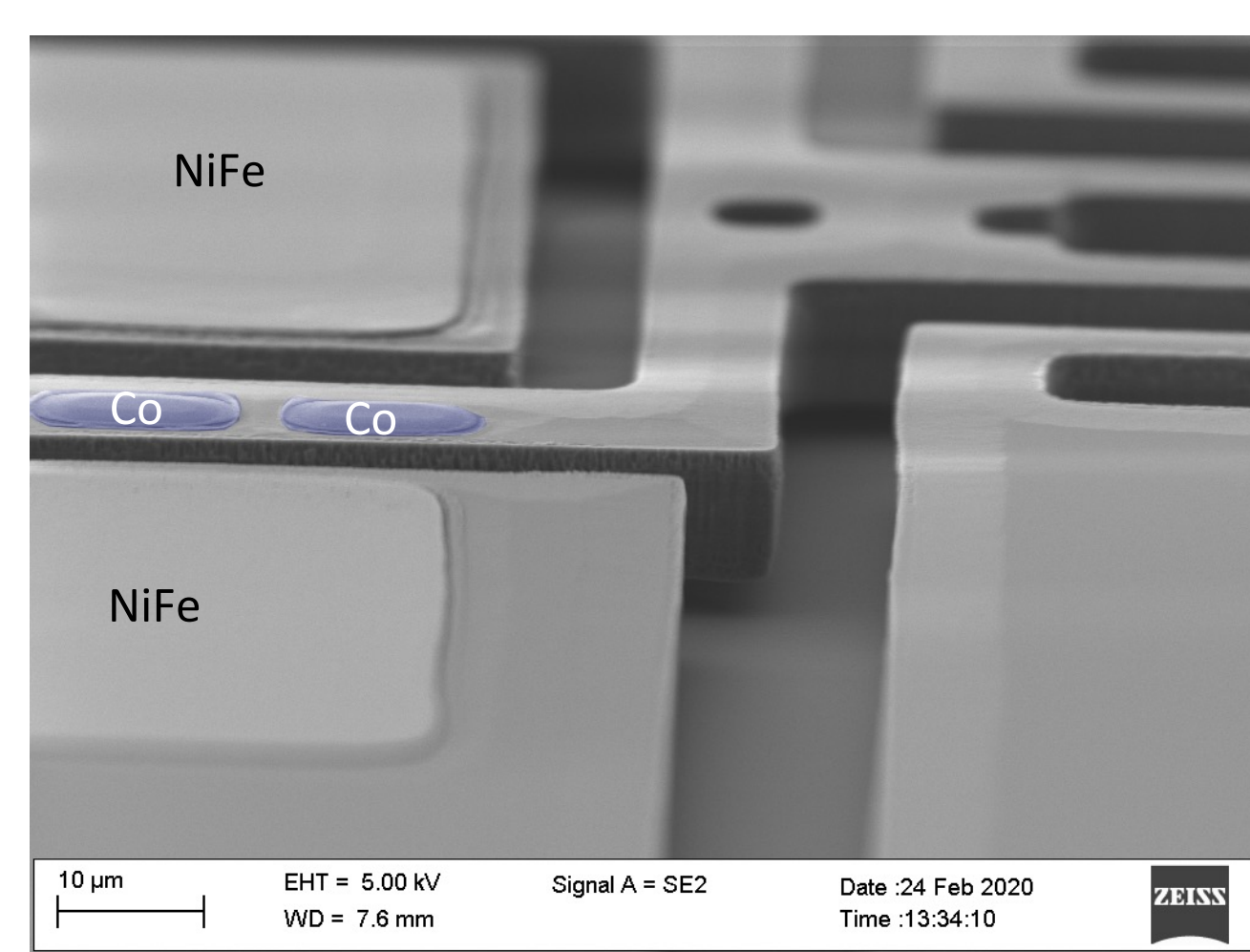
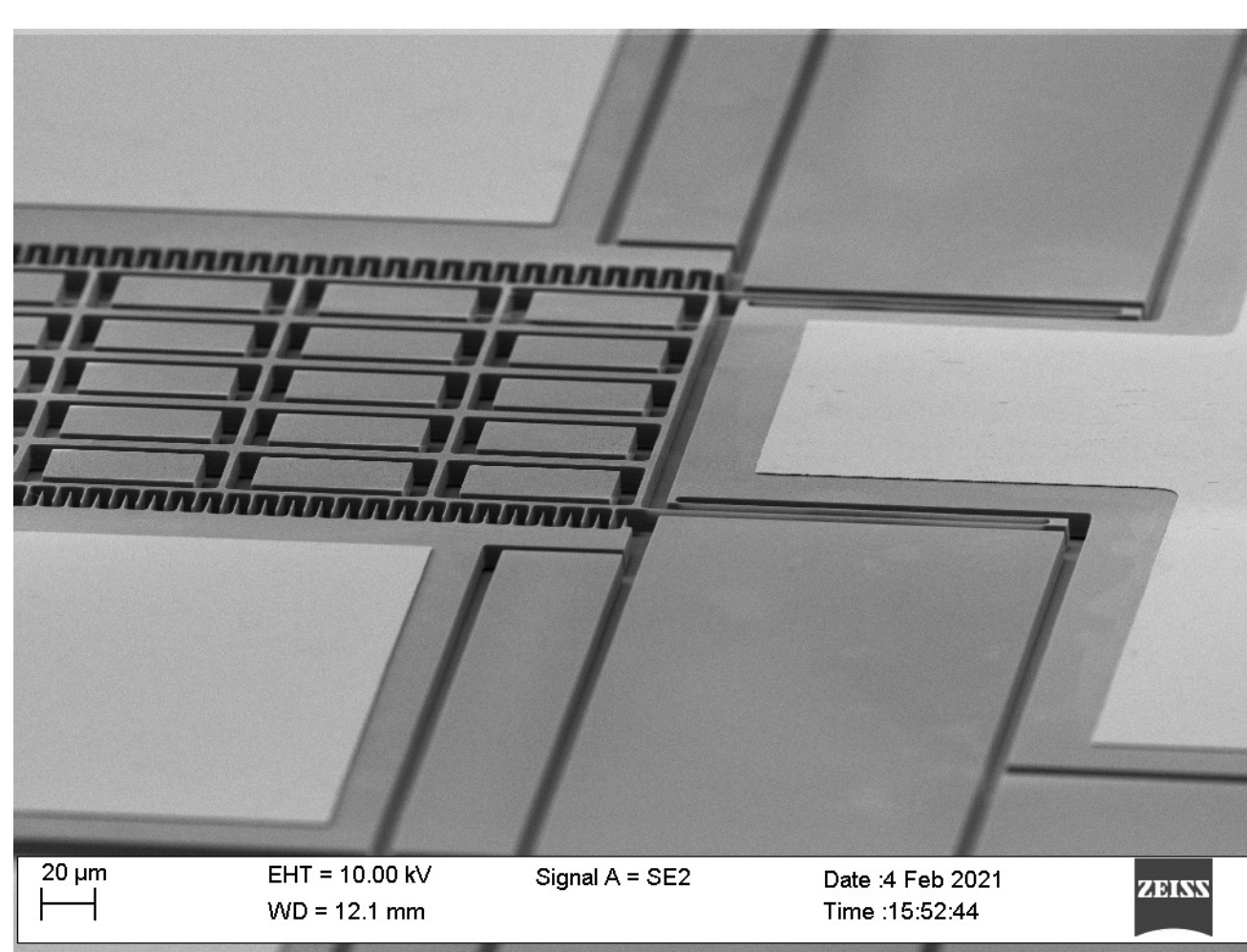


4. Reactive-ion etching

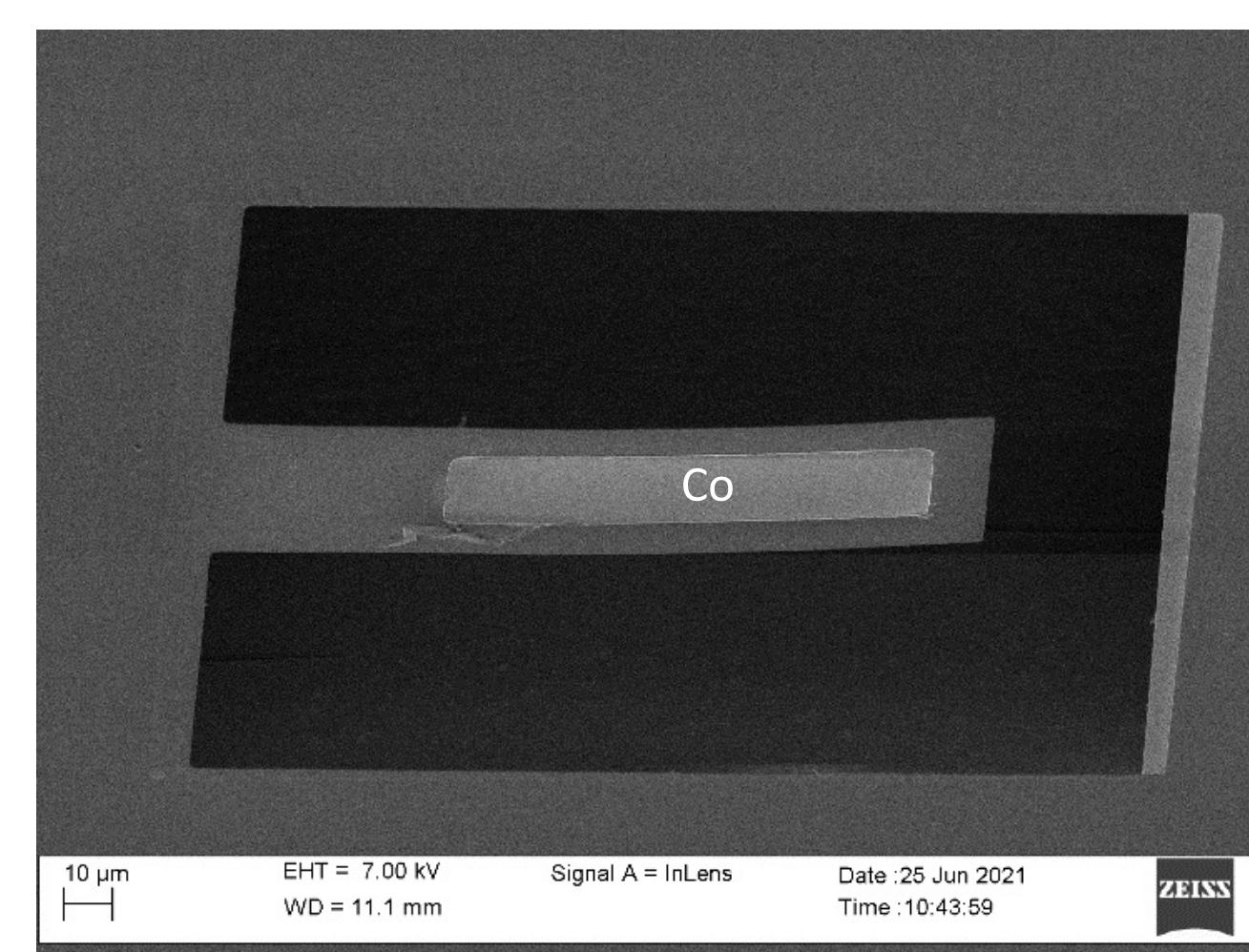
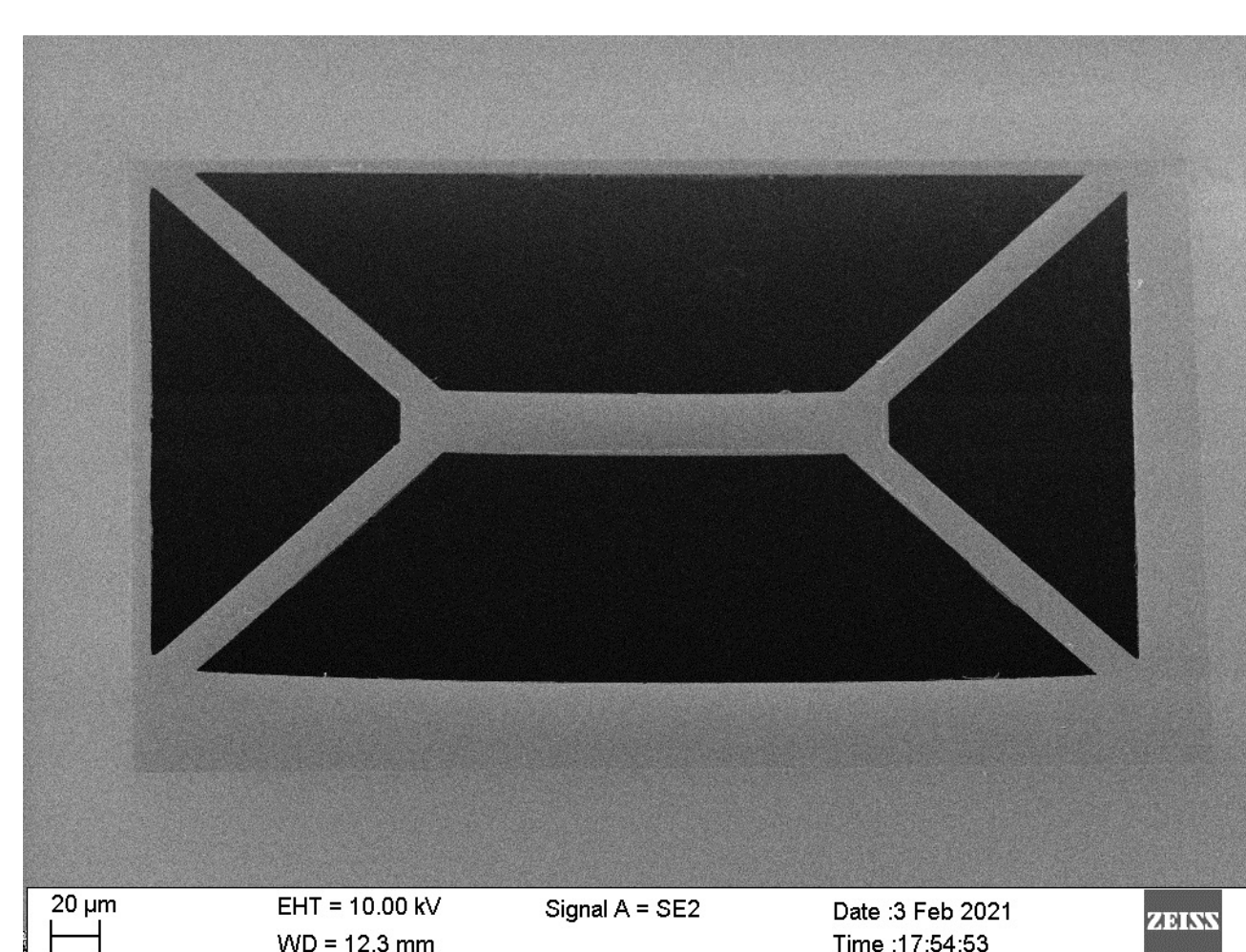


Fabricated devices

SOI process

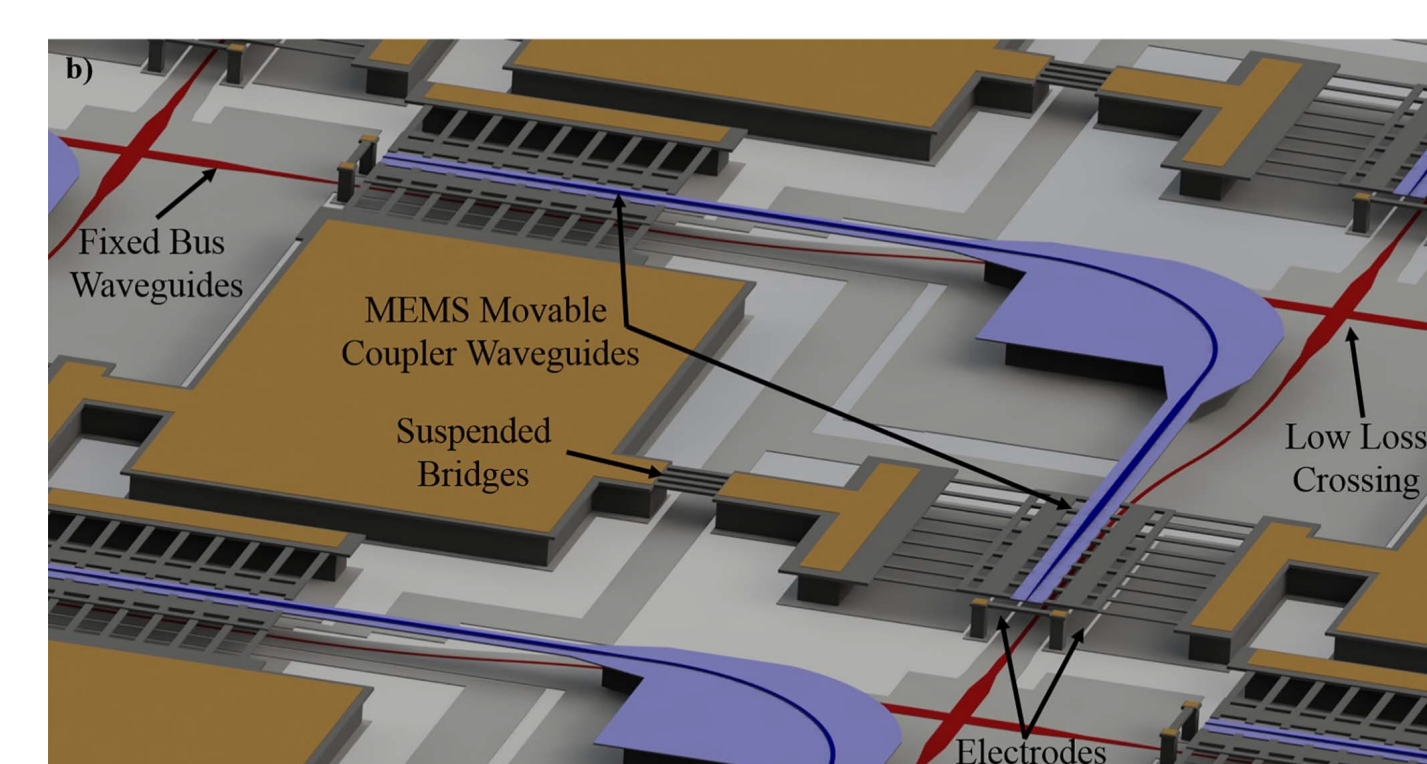


SiN process

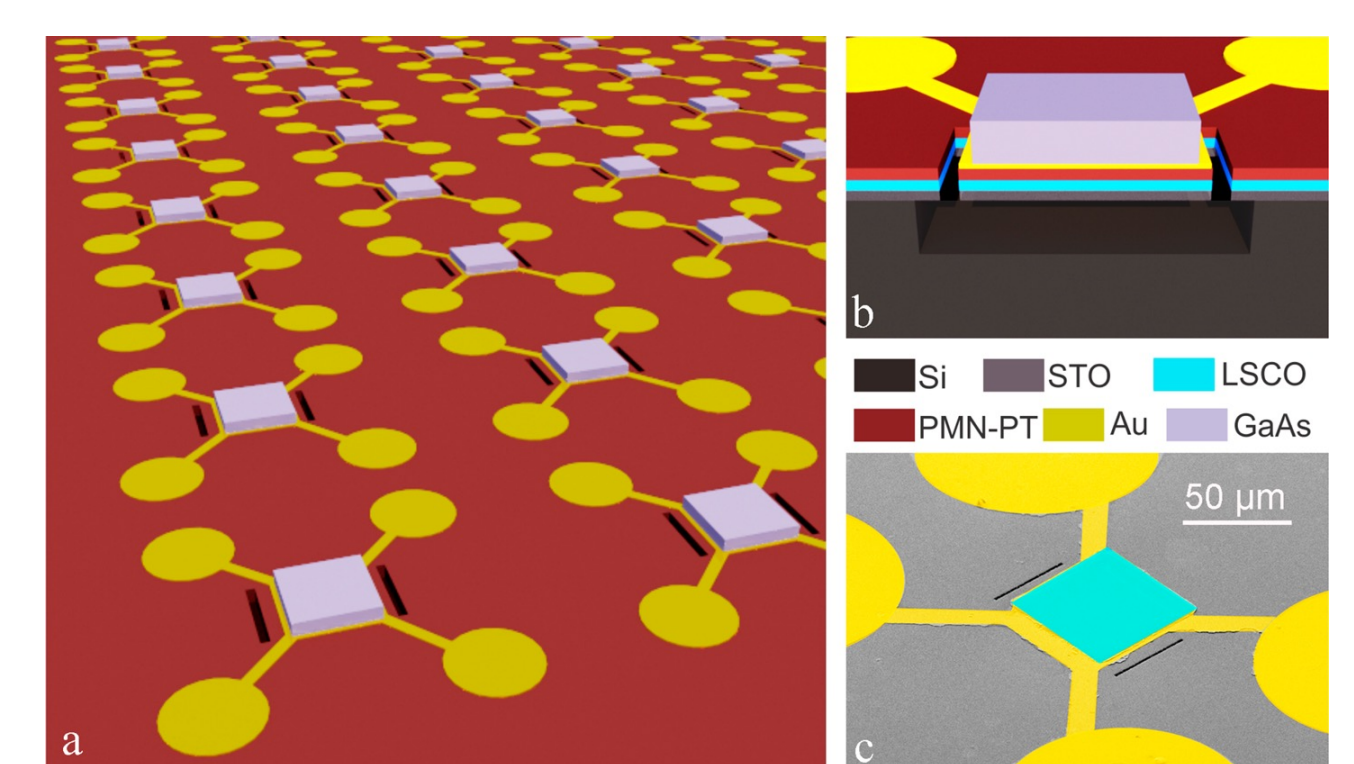


Future applications

MEMS technology will play a fundamental role in **tomorrow applications...**

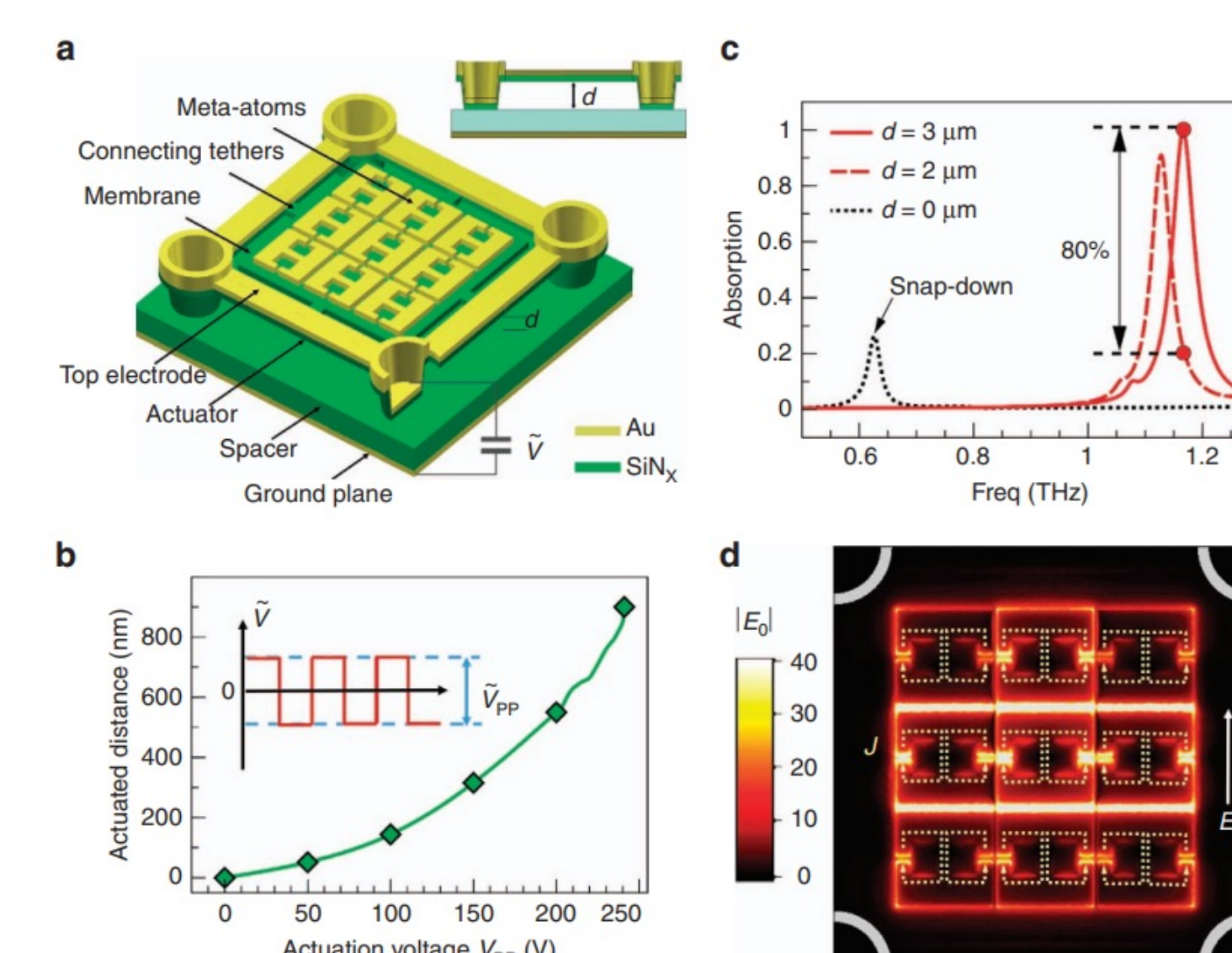


MEMS for silicon photonics [1]

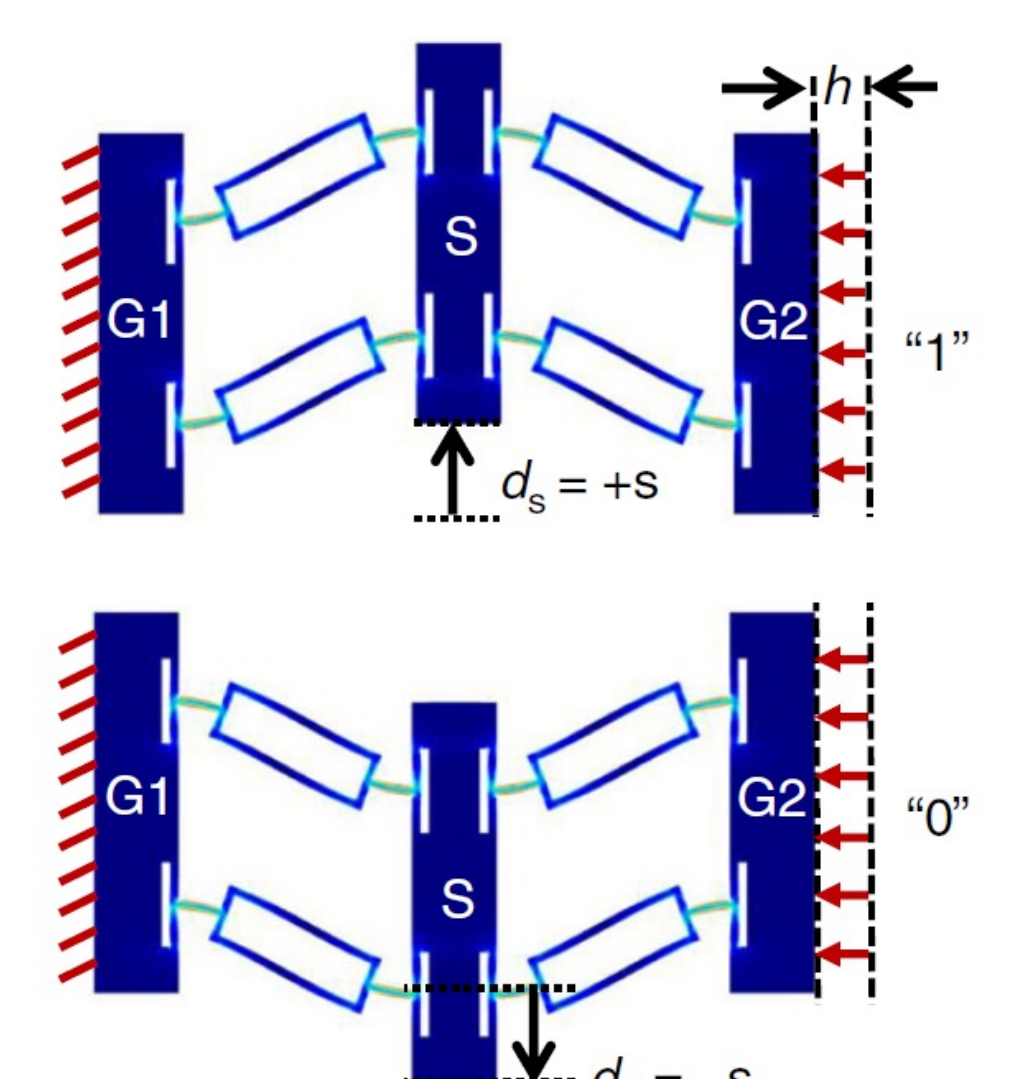


MEMS quantum dots [2]

... and will improve the performances of the existing ones



MEMS THz absorber [3]



MEMS logic port [4]

References

- [1] Quack, N. et al. (2016). Scalable row/column addressing of silicon photonic MEMS switches. *IEEE Photonics Technology Letters*, 28(5), 561-564.
- [2] Zhang, Y. et al. (2016). Monolithically integrated microelectromechanical systems for on-chip strain engineering of quantum dots. *Nano letters*, 16(9), 5785-5791.
- [3] Liu, M. et al. (2017). Ultrathin tunable terahertz absorber based on MEMS-driven metamaterial. *Microsystems & nanoengineering*, 3(1), 1-6.
- [4] Song, Y. et al. (2019). Additively Manufacturable Micro-Mechanical Logic Gates. *Nature Communications* 10, 1–6.

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