

MEMSLand

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Cost Effective MEMS to Develop a Sustainable High Tech Business



Point-One

Pole of innovative technology on nanoelectronics and embedded systems

Outline

- Intro: what are MEMS
- Project Objectives / Deliverables
- How did we do
- Conclusion

MEMSLand

Large industry



Institutes



Universities

SME



MEMS: Micro Electro-Mechanical Systems

To put it simple, chips that include non-CMOS:

More than Moore

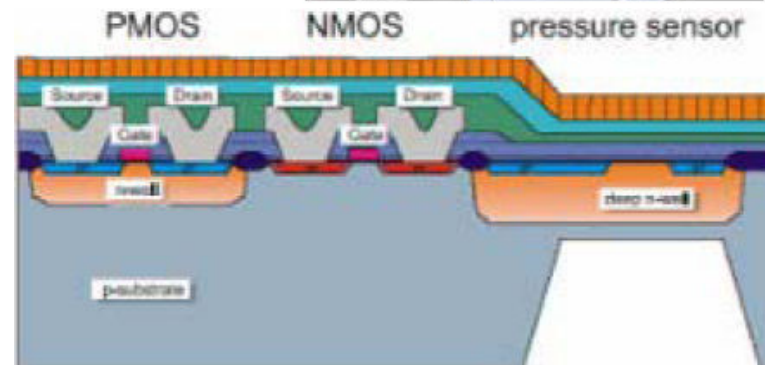
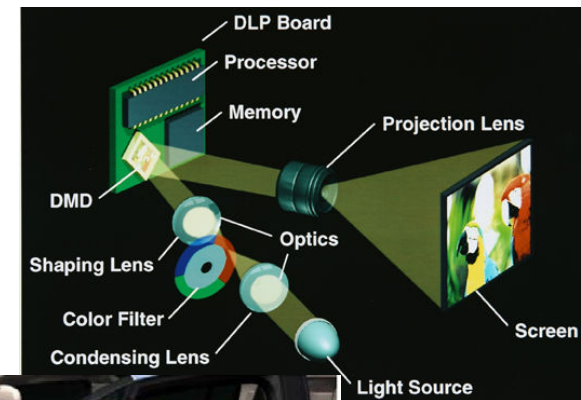
- Sensing elements
- Low-loss switches
- Micro-mirrors
- ...

Advantages:

- Smaller feature size:
Integration in single IC package
- Lower-cost:
Use semiconductor technology for mass-production
- CMOS integration makes (non-ideal) Si-based sensors more ideal

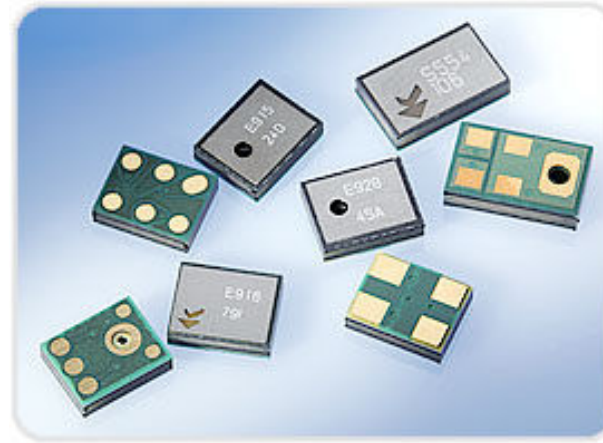
What are successful MEMS

- DLP Technology (TI)
- Accelerometers/gyroscopes (Bosch, ST, Freescale)
- Pressure sensors (many companies)

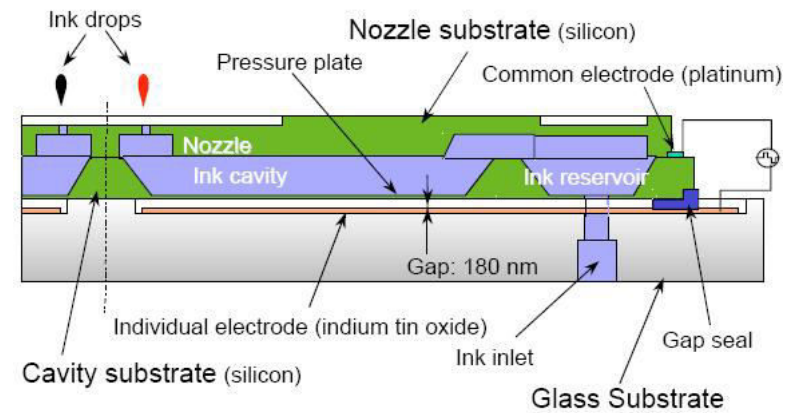


What are successful MEMS

- MEMS-microphone (Knowles, EPCOS)



- Inkjet printers



Project Goals at start-up meeting

- The objective of this project is to develop and integrate all key competencies and technologies needed for cost effective **MEMS (packaging) solutions**.
- Cooperation on a national scale covering the complete value chain, linked with international partnership and networks, will be needed to achieve cost effective options of new **MEMS device creation**.
- In addition, the project will enhance the education of highly qualified peoples in this complex field. This will result in a sustainable innovation environment and world-class competitive strength of the Netherlands in the emerging sensor/actuator/MEMS business.

Objectives MEMSLand

- Put The Netherlands on the MEMS map
- Employment
- Alignment between institutes and industry
- Stimulation SME
- Standardization MEMS

Goals: MEMSLand Demonstrators

BC1 BAW filters

NXP, ALSI, AppTech, UT

BC2 RF MEMS switch

EPCOS, NXP, Fraunhofer

BC3 MEMS XO Oscillator

NXP, TU/e, BRUCO

BC4 microGC gas analyzer

C2V, ALSI, Boschman, AppTech

BC5 Non-volatile memory chip

Cavendish, ALSI, IMEC

BC6 Optical sensor

Lionix

BC7 1×32 info planar splitter

Lionix, Boschman, MA3

D8 Miniature camera packaging

Anteryon, Boschman, MA3, TNO

D9 Fingerprint and pressure sensor

Boschman, TNO

D10 Scanning mirror

Philips AppTech

D11 Large area micro assembly

TNO

MEMS**Land** project organization

- Overall project management, NXP (Erik van de Riet → Peter Magnée)
- WP1: Technology platforms and business carriers, C2V (Vincent Spiering)
- WP2: Functional modeling and design, EPCOS (Marcel Giesen)
- WP3: Wafer processing and packaging, Philips (Eric van Grunsven)
- WP4: Material characterization and design for reliability, TUD (Willem van Driel)
- WP5: Design for manufacturability and testability, Cavendish (Cor Schepens)
- WP6: Fast prototyping and industrialization, Boschman (Ton van Weelden)
- WP7: Dissemination, TNO (Jan Eite Bullema)

The team is virtually unchanged over the course of the project:
very stable organization

Put The Netherlands on the MEMS map

- Several Business Carriers have resulted in publications that are received well in the world.
 - *e.g.* MEMS-XO with world-record Q-factor
 - BAW-filters: several good publications and patent applications, especially on balun application
 - Several other good examples will be discussed later Today

Employment

- Innovation activities have resulted in a number of new jobs
 - *e.g.* since the spin-out of the RF-MEMS activity from NXP to EPCOS, this department has grown significantly
- MEMSLAND has not yet taken the step to large volume manufacturing
- The road to industrialization in Europe has several challenges:
 - \$/€ ratio
 - Required investments
 - Combine the volumes of SME's to get some critical mass
 - Severe competition from Asian governments actively supporting production
 - Joint collaboration between government, industry and academia is essential
- Despite the global crisis, employment has stayed stable

Alignment between institutes and industry

- During the 4 years the MEMSLand program has run, very good cooperation's between Universities and Institutes on the one hand and the industry/SME on the other hand have been formed/strengthened.

Stimulation SME

- SME's are participating well within the consortium.
- Large number of SME partners.
- Several good cooperation between large industries like Philips and NXP have been formed with SME's that would otherwise have most likely not have happen.

Standardization MEMS

- This objective has proven to be too ambitious, MEMS as a whole are too diverse to be gathered under one standardization umbrella.
 - This is also recognized elsewhere: no big theme anymore
- Within the consortium, however, several cross-learning's have been made.
 - *e.g.* the miniature camera from Anteryon would not be possible without wafer-level packaging from the silicon industry.

What could improve

- Final approval took [too] long
 - PhD students can not start in the past
- Full financial closure per year added a significant additional administrative burden.
- Business Carriers and Demonstrators are most often “stand-alone” projects, interaction at Work-Packages level varies per BC
 - Conscious choice: focus is on BC
 - Dissemination as **one** MEMSLand lagging
 - Most BC’s itself are very strong

How to continue

- MEMSLand has proven to be very effective in bridging the “gap” from a *research demonstrator* to an *industrial proto-type*
- Many positive discussion ongoing between partnership formed during the MEMSLand project
- It is essential to understand that SME’s are less likely to *buy* research directly from academia: stimulation of SME participation also means providing the means to create industrial proto-types

Conclusions

- MEMSLand project is (almost) finished, with all Business Carriers / Demonstrators showing good results
 - not all resulted [yet] in business, but they all enhanced our technical expertise/know-how
- Until Today up to 39 scientific publications
- Good co-operation between various partners
- Discussion ongoing for continuation after MEMSLand, *e.g.* Open Innovation to Industrialization Center (I2I)
- Strong SME participation
- We had (still have) lots of FUN!!