

Why the semiconductor industry (still) needs physicists

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Outline:

- ✗ The evolution of semiconductor industry.
- X Principles and architectures of memory.







- X Semiconductor industry integrates electrical circuits in one "chip".
- ✗ These "chips" get basic ingredients for many products (cars, computers, telephones, ...)
- ✗ By <u>high integration</u> of functions and the <u>easy replication</u> of chips the information age was possible







The evolution of the semiconductor industry

"To handle the complex technology integrated device manufacturers grew to realize profits by economy of scale."



"Evolution from integrated device manufacturer to several specialized player started already."

Quelle: C'T, Infineon, ITRS

Design Technology Interface

What are the tasks?

- X We get devices from the technology and adapt models for the product development.
- X We keep track that our models cover the technology variations.

Why are there physicists?

- ✗ We have to understand the physics behind the model and understand what the process engineers do.
- X We have to judge the validity of the model and do physical based extrapolation.



Memory principles and architectures

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ROM (read only memory)



The memory is organized as an array. The memory cells are address by the wordline and the information is passed to the bitlines.

As most of the memory chip is covered by the array, the size of the memory cell determines in the end the price of the chip.



DRAM, EPROM, EEPROM

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DRAM (dynamic random access memory).

EPROM (electrical programmable read only memory, erased by UV light).



EEPROM (electrical erasable and programmable read only memory). To erase the information electrically a two transistor cell or a split gate is necessary.



Flash memory (NOR, NAND Architecture)

Flash Memory can be programmed end erased electrically as the EEPROM. But a whole sector is erased before new information is stored and so no additional transistor is necessary.

NOR



NAND



"normally ON" transistors

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Summary

X The semiconductor industry needs physicists.

The semiconductor industry did not end up in few big players but many specialists evolve.

Memory development still follows Moore's Law and makes a lot of fun.

Literature:

[1] K.Hoffmann: Systemintegration, Oldenburg Verlag, München (2003) .

[2] ITRS: http://public.itrs.net/

[3] Infineon Technologies AG: Halbleiter

