# Semiconductor Industry – a fascinating and large career opportunity

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CTO Picosun BU

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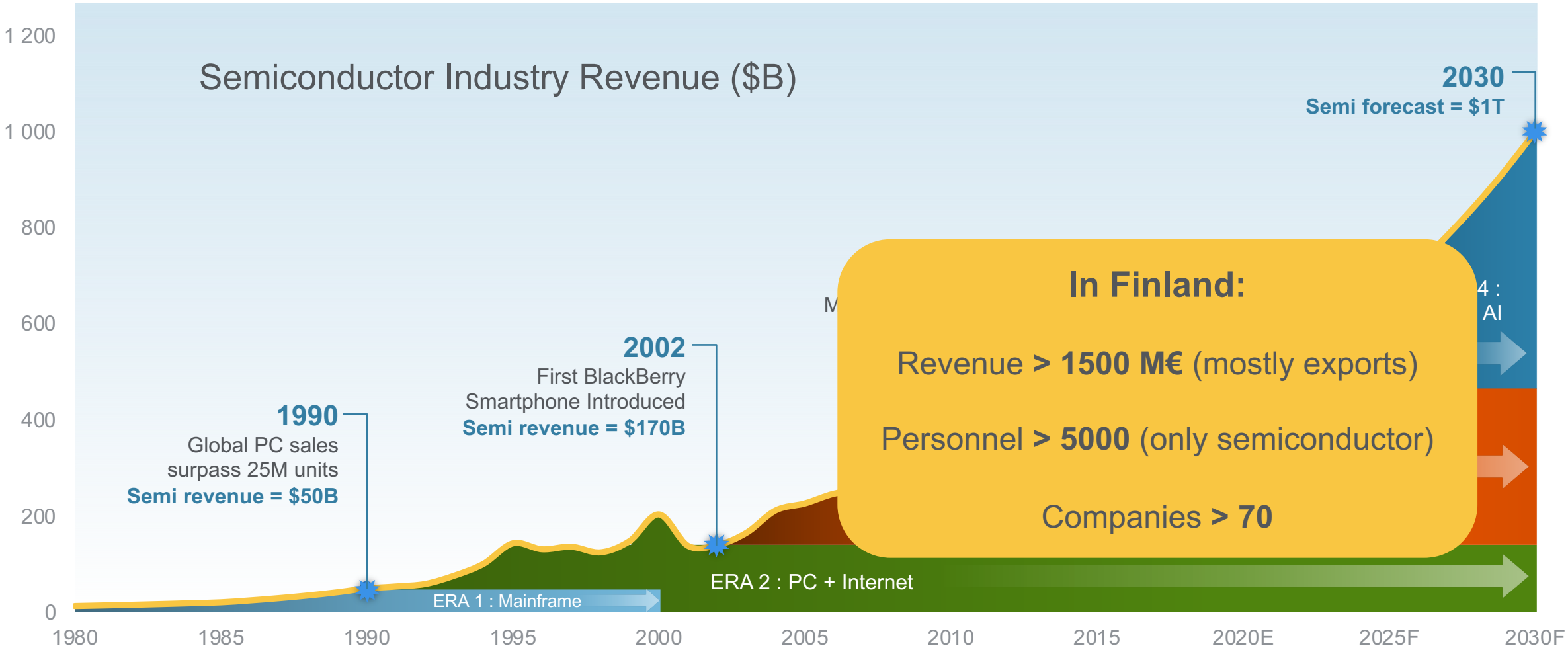
APPLIED MATERIALS®
make possible

# AGENDA

- Semiconductor Industry
- Picosun and Applied Materials – Just Married!
- How to make chips and what is ALD
- What does it mean?

# Semiconductor industry is large and growing – also in Finland




## AI Era is the 4th and Biggest Age of Computing

Source: SIA, Applied Materials - SMI

- ALD production started in 2004
- 200+ employees, 19 different nationalities
- HQ and factory in Finland
- 30+ sales partners on six continents
- Order intake 2021 €42,5M
- Turnover 2021 €38,4M
- R&D investment around 15% of revenues
- Significant annual growth sustained for several years

# ALD products

## FROM MARKET LEADERS IN R&D TO PRODUCTION-PROVEN INDUSTRIAL ALD

**THE ONLY ALD COMPANY IN THE WORLD** with full range of ALD solutions from basic R&D to fully automated high volume industrial manufacturing.

**SERVICE PORTFOLIO** covering customer's whole ALD journey, from initial applications consultancy to turn-key system delivery, training and full lifecycle management.




picosun
AN APPLIED MATERIALS COMPANY


FOUNDED IN 1967

# Applied Materials - World's #1

## semiconductor and display equipment company

**$25.79 billion**
revenue
TOTAL FISCAL 2022

**$2.8 billion**
R&D spending

**~15,700**
patents*

**~33,300**
employees
in **19*** countries

Data as of fiscal year end, October 30, 2022 except * which are as of fiscal year end, October 31, 2021



- Applied Materials acquired Picosun June this year – we are part of Applied now!
- The most leading edge technologies are developed in Finland as well

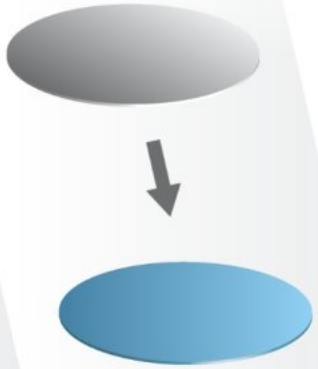
# How to Make a Chip

APPLIED MATERIALS make possible

## FROM SAND TO WAFER

Silicon, the second most common element on Earth, is refined from sand into pure silicon dioxide, and then melted and pulled to form a cylinder called a crystal ingot.

The ingot is polished and then sliced into thin wafers – typically 300mm or 12 inches in diameter.



## WAFER PREP

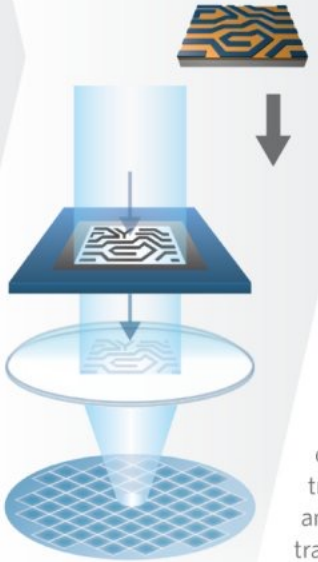
A pure layer of silicon is grown on the wafer surface using a process called Epi to protect the underlying silicon during subsequent steps.

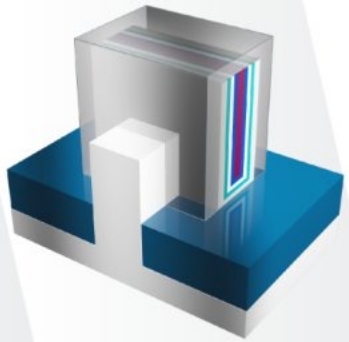
Next, the wafer is spun and uniformly coated with a thick light-sensitive liquid called photoresist.

## PATTERN FORMATION

Circuit patterns are drawn on a clear stencil-like mask, and transferred to the photoresist using ultraviolet light.

Materials in unexposed areas are etched away, leaving a 3D pattern on the wafer. These steps repeat multiple times and require precise measurement.





## TRANSISTOR FORMATION

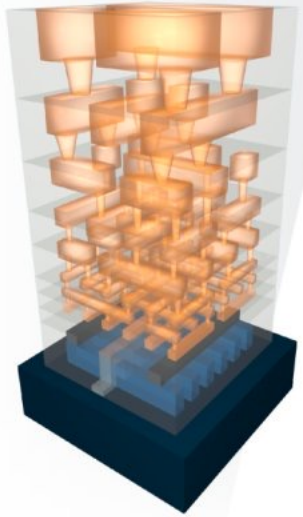
The transistor is the fundamental building block of electronics. It is a switch or gate that regulates voltage. Advanced chips can contain 12 billion transistors.

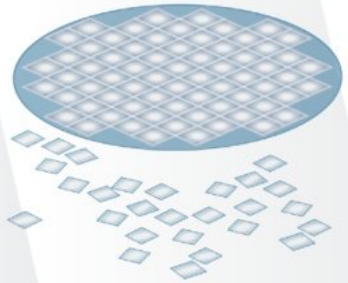
Switching a gate open allows current to flow through a channel from a source to a drain. Etch and deposition steps form the transistor. Ion implantation and thermal steps improve transistor speed by modifying the silicon to conduct current faster.

## CONNECT TRANSISTORS

Wires connect transistors to route electronic signals out of the chip, and are created by patterning and etching circuit lines, then filling them with metal.

A single chip can contain more than 12.5 miles of wiring spanning multiple levels.



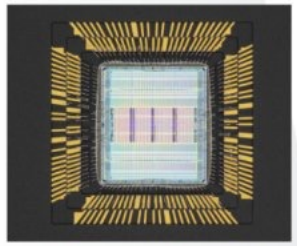


## CUT INTO SINGLE CHIPS

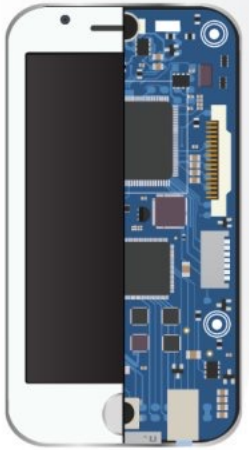
When the wafer is finished being processed, the surface is now covered with multiple semiconductors. The wafer is sliced into individual semiconductor "chips."

## PACKAGING

The chips are then placed in a lead frame forming a protective housing.

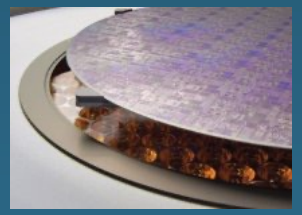


Each chip is tested before being packaged. They are now ready to be used in computers, mobile devices and many other products.



# Tools needed for high volume manufacturing


Deposition


Thermal


Metals


Planarization


Inspection


Etch


Plating


Implant

- In reality, the production flow requires multiple different tools
- For instance, ”Deposition” covers PVD, CVD and ALD tools

# ALD – The Finnish innovation which is essential for modern leading edge components

- The most advanced thin film coating technique of today
- Precise control of the film thickness and structure down to nanometer level
- The highest film uniformity and conformality over and inside the smallest nanoscale features
- Dense, pinhole-free and defectless films
- Digitally repeatable process
- Low process temperatures, gentle to sensitive substrates

**Key enabling technology in modern IC industry!**

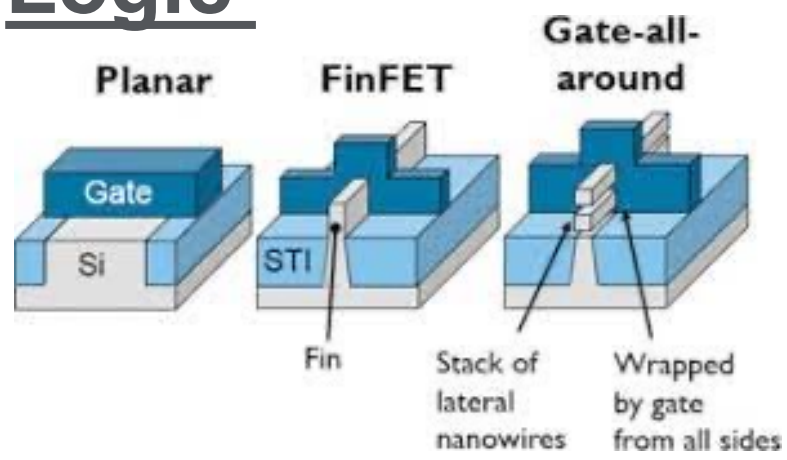
# HOW THIS WOULD BE EVEN POSSIBLE WITHOUT ALD?

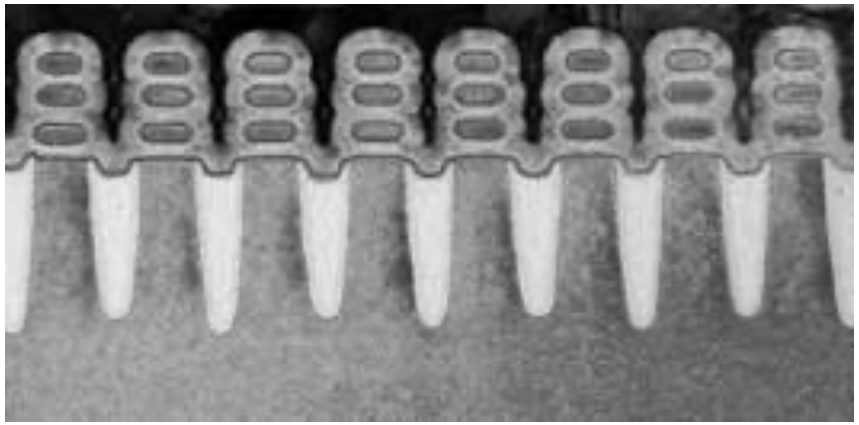
SUPERIOR

Other thin film coating methods

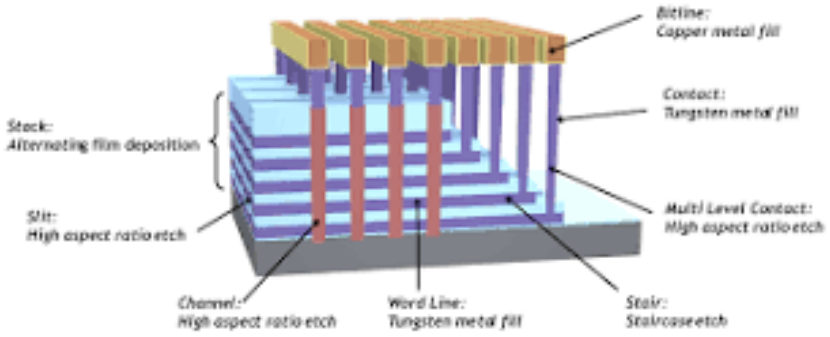
ALD

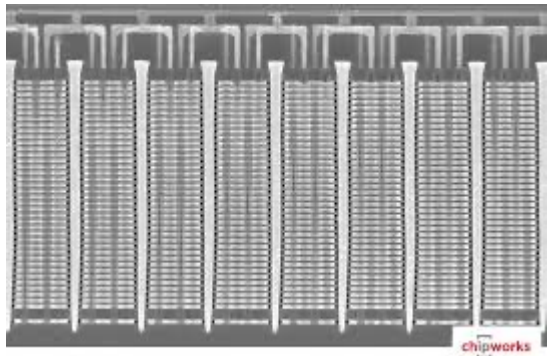
## Logic



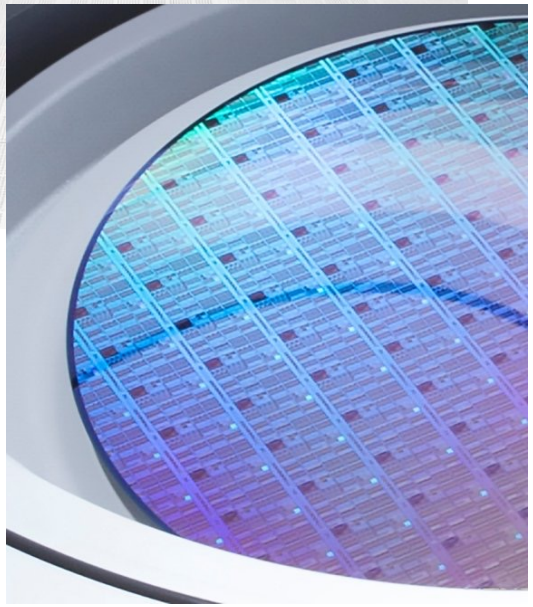
## Memory




Close-up image of V-NAND flash array

# What kind of people and competences are needed – In Finland and globally



**Physics (Semiconductor, plasma, nanotechnologies, quantum, etc.)**

**Chemistry**

**Simulations**

**Advanced mechanics**

**Electric design**

**SW developers**

**Automation**

**Machine learning**

**Data analysis**

**…**


# Make Possible® a Better Future

Applied Materials is the leader in materials engineering solutions used to produce virtually every new chip and advanced display in the world and we are uniquely positioned to help Make Possible a Better Future.

APPLIED MATERIALS®

make possible