

Nano überall ?

A dark, high-magnification microscopic image of a microchip, showing a grid of small, circular structures and various rectangular components.

Matthias Studer
m_studer@gmx.ch

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Nano überall ?

- Was ist Nano
- Mikroskop
- Wo ist Nano
- Nano in der Technik
- Gefahren

A dark, high-magnification microscopic image of a microchip, showing a grid of small, circular structures and various rectangular components.

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Was ist Nano

$$1\text{ nm} = 10^{-3}\mu\text{m} = 10^{-6}\text{mm} = 10^{-9}\text{m}$$

$$1\text{ m} = 1000\text{mm} = 1000'000\mu\text{m} = 1000'000'000\text{nm}$$

3

Was ist Nano

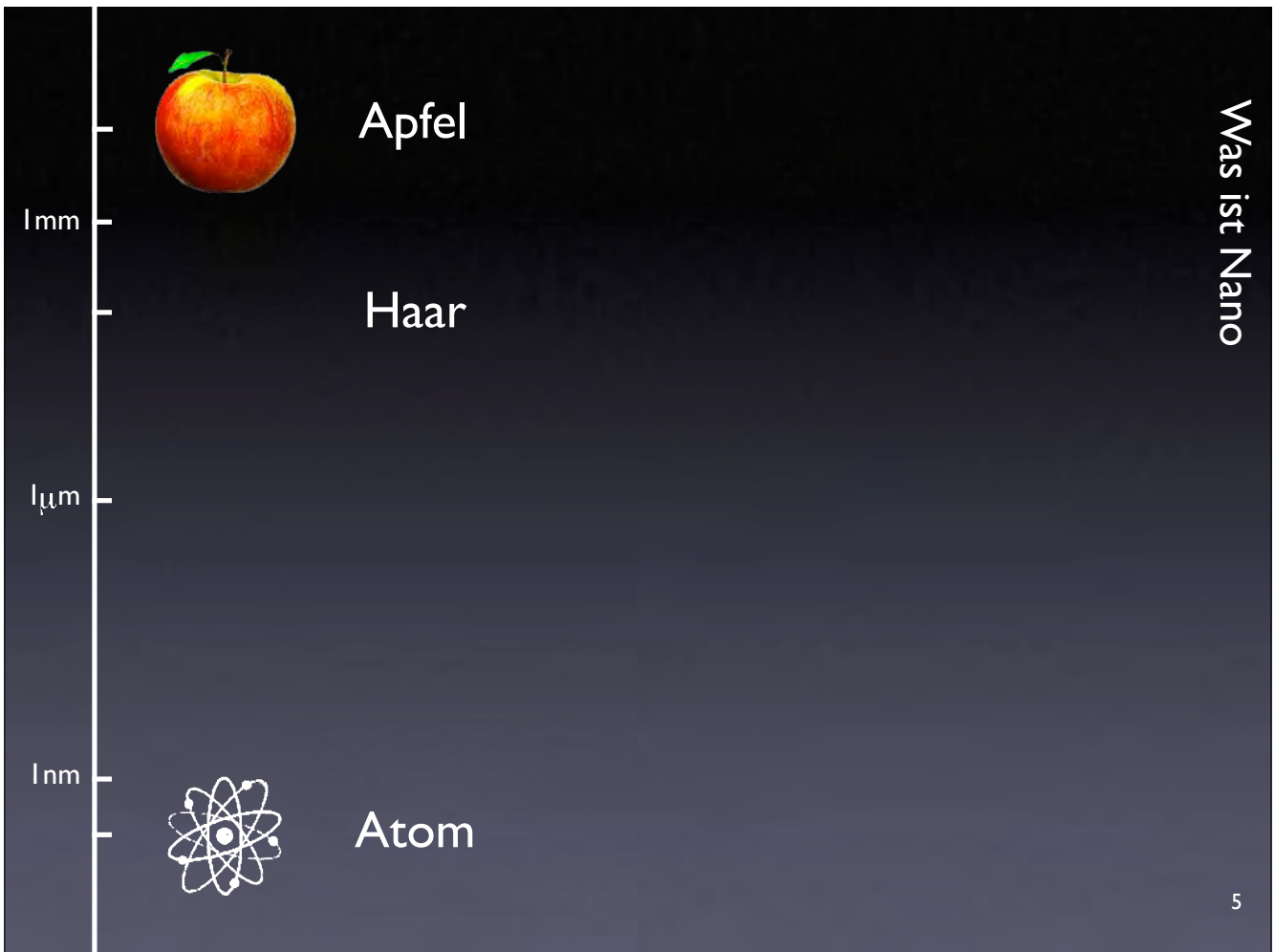
6000
km



10cm

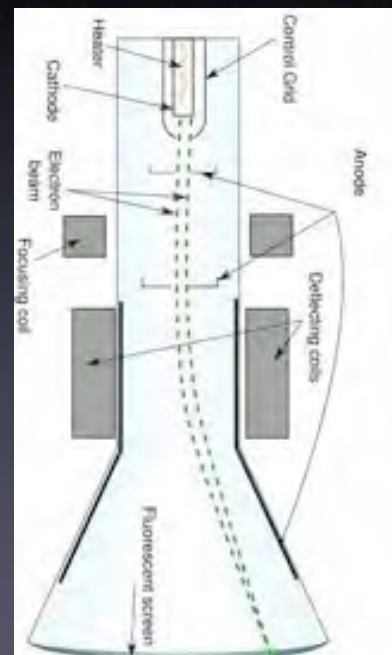


4



Mikroskop

Scanning electron microscope





1mm

Haar

Scanning electron microscope

1µm



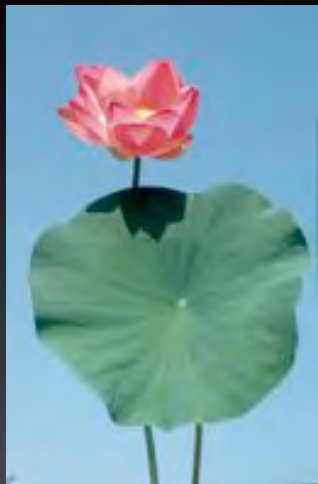
1nm



1mm

Haar

Wo ist Nano



Lotusblume, Lotus-Effekt

1µm



1nm

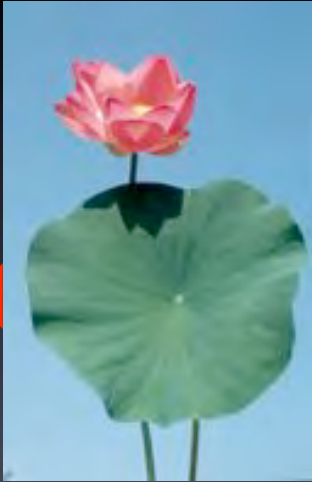




Wo ist Nano

1 mm

Haar



Lotusblume, Lotus-Effekt

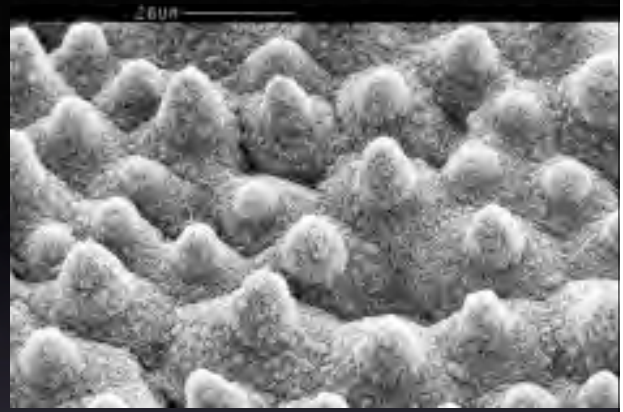
1 μ m



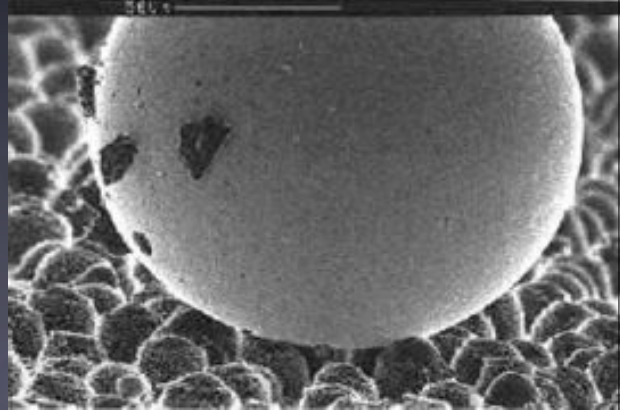
1 nm



Oberfläche



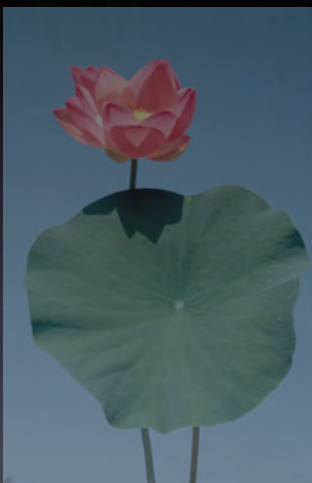
Wassertropfen mit Schmutzpartikeln



Wo ist Nano

1 mm

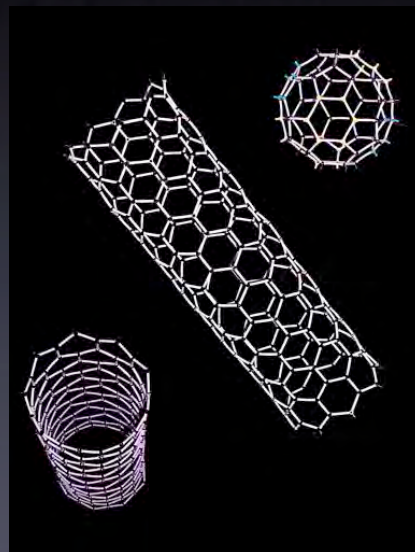
Haar



Lotusblume, Lotus-Effekt

1 μ m

1 nm



Carbon Nano Tubes





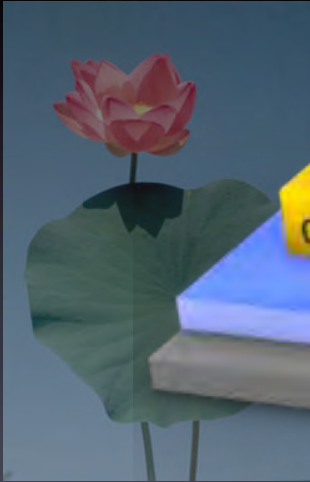
Wo ist Nano

1mm

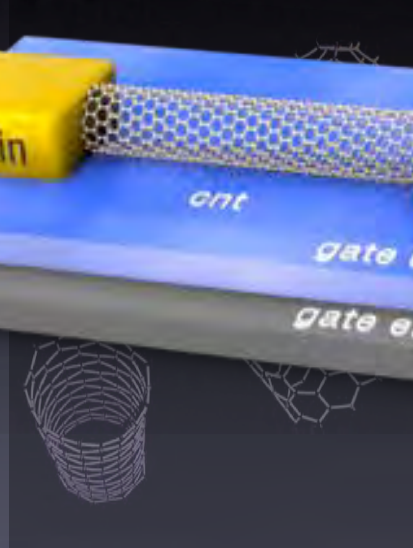
Haar

1µm

1nm



Lotusblume, Lotus-Effekt



Carbon Nano Tubes



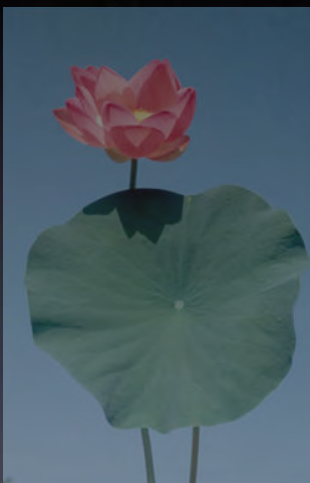
Wo ist Nano

1mm

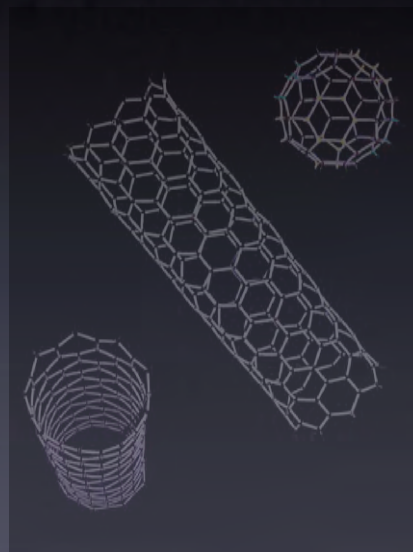
Haar

1µm

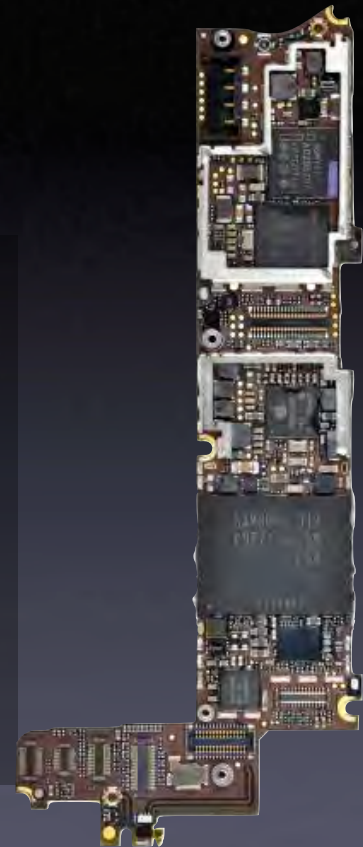
1nm



Lotusblume, Lotus-Effekt



Carbon Nano Tubes



Elektronik



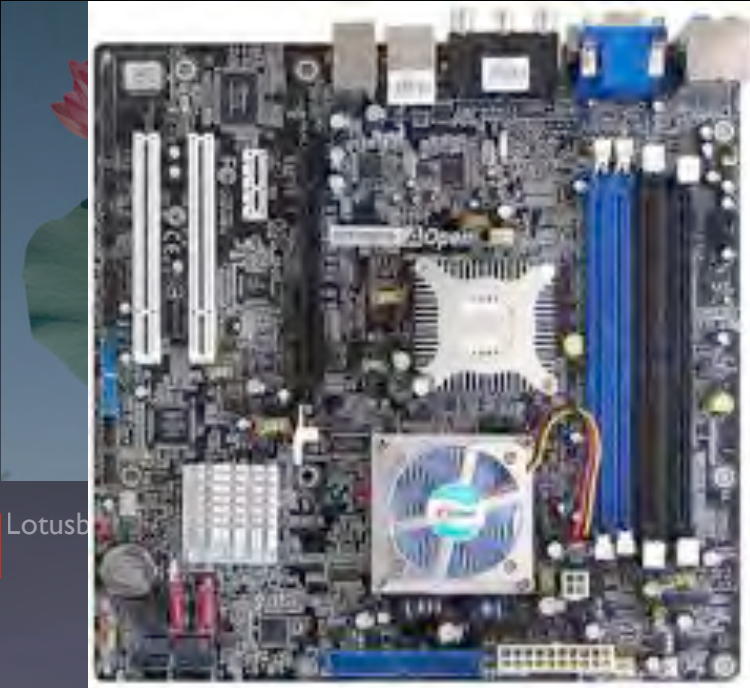
Wo ist Nano

1mm

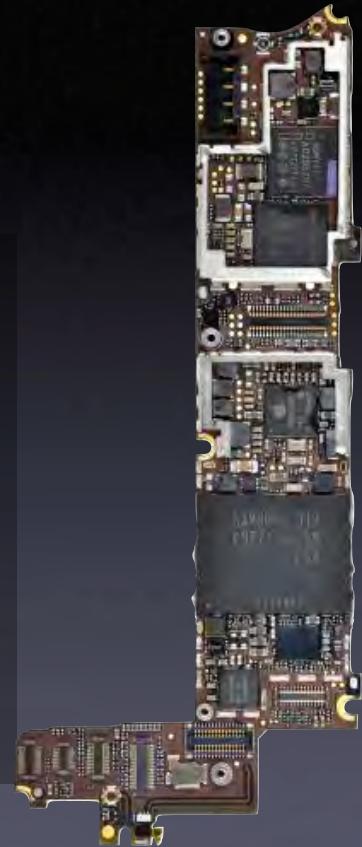
Haar

1µm

1nm



Lotusb



Elektronik

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Wo ist Nano

1mm

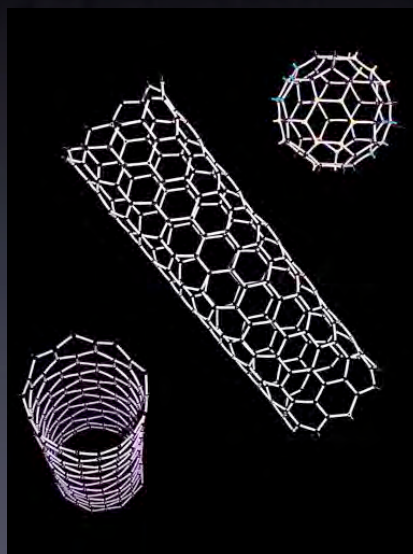
Haar

1µm

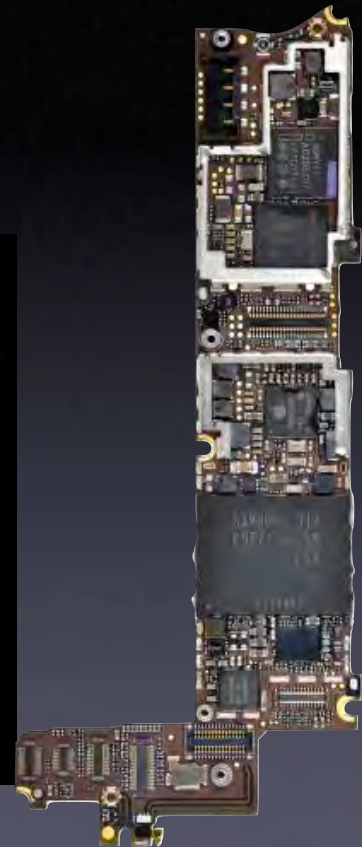
1nm



Lotusblume, Lotus-Effekt



Carbon Nano Tubes



Elektronik

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Manipulation von Atomen

1mm

Haar

1µm



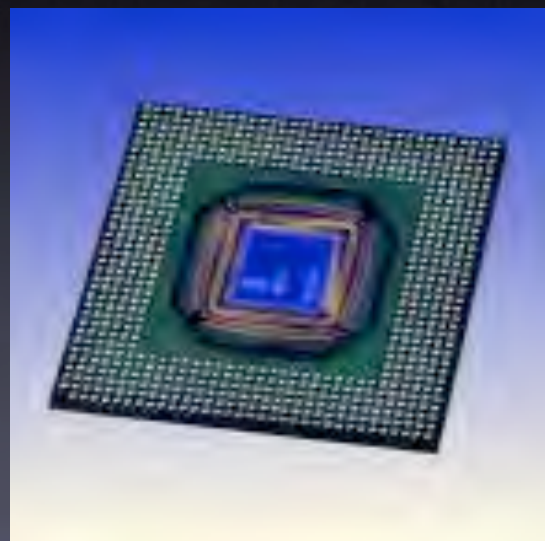
315nm
≈ 3150 Atome

1nm



Nano in der Technik

(Elektronik)





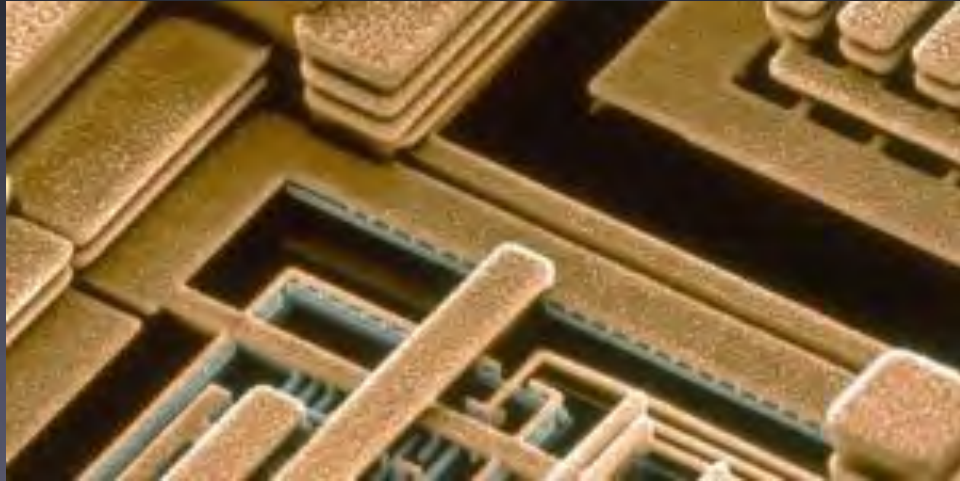
1 mm

Haar

1 μ m



1 nm



Chip Produktion

Grundplatte (Wafer)





1mm

Haar



1µm

1nm



reale, verunreinigte Oberfläche
(Fingerabdruck)



1mm

Haar

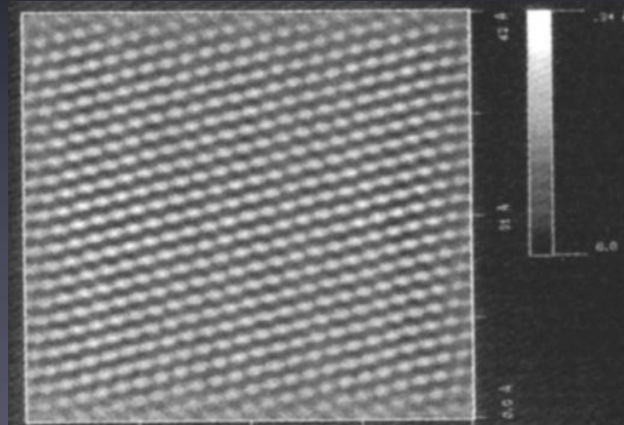
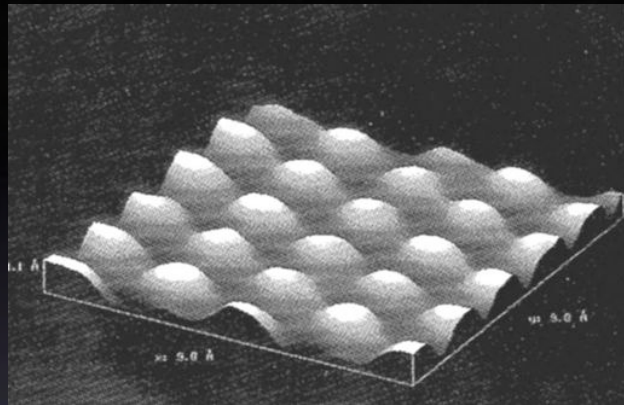
ideale Oberfläche

1µm

1nm



ideale Oberfläche



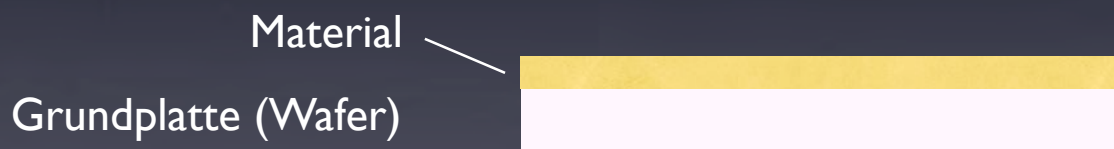


Wafer

Grundplatte (Wafer)



Schritt I



LPCVD Reaktor



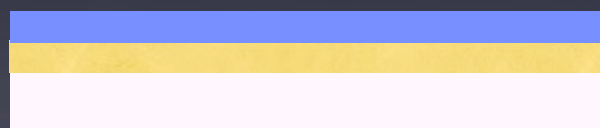
LPCVD Reaktor

Schritt 2

photosensible Schicht

Material

Grundplatte (Wafer)





Spinner

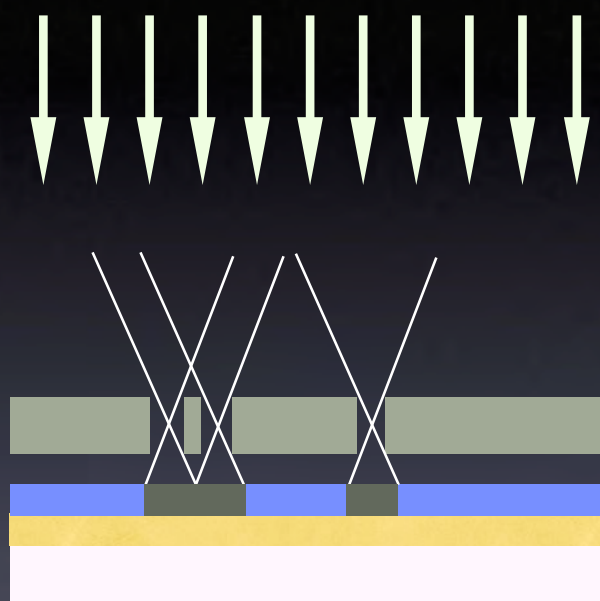
Hot plate

Schritt 3-5

Belichten

UV, Röntgenstrahlen

Maske (Gitter)
photosensible Schicht
Material
Grundplatte (Wafer)



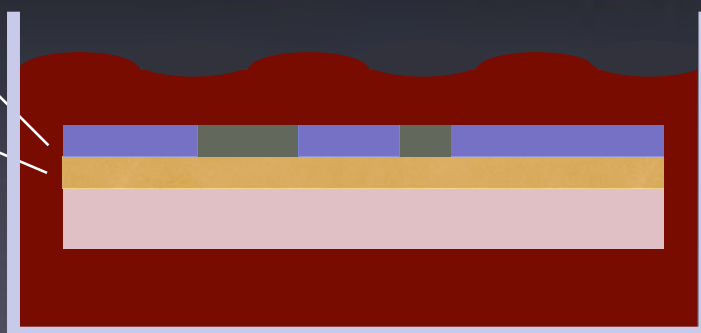


Mask aligner

Schritt 6

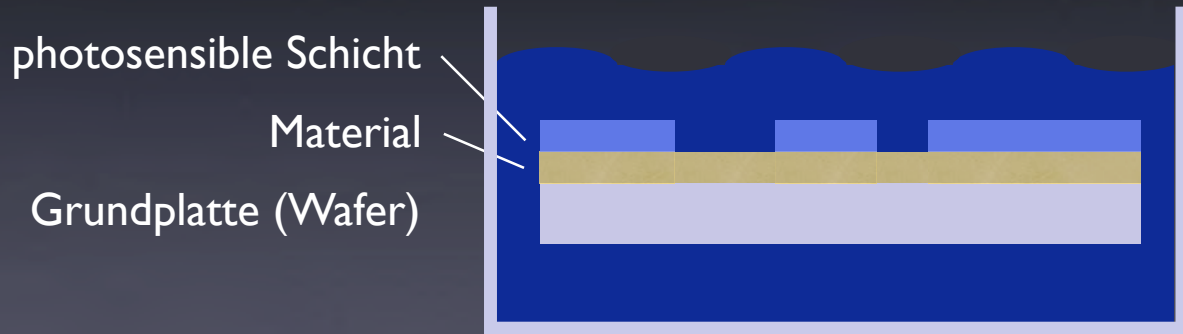
belichtete Teile von
Photoschicht wegätzen

photosensible Schicht
Material
Grundplatte (Wafer)



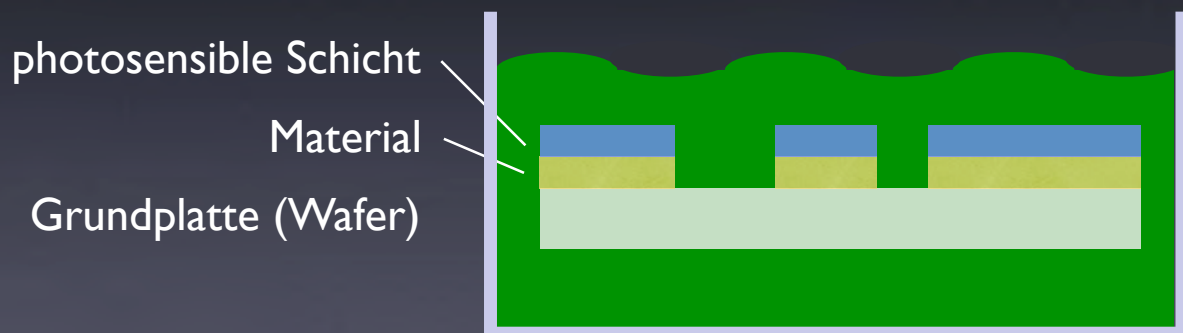
Schritt 7

Material wegätzen



Schritt 8

Photoschicht wegätzen





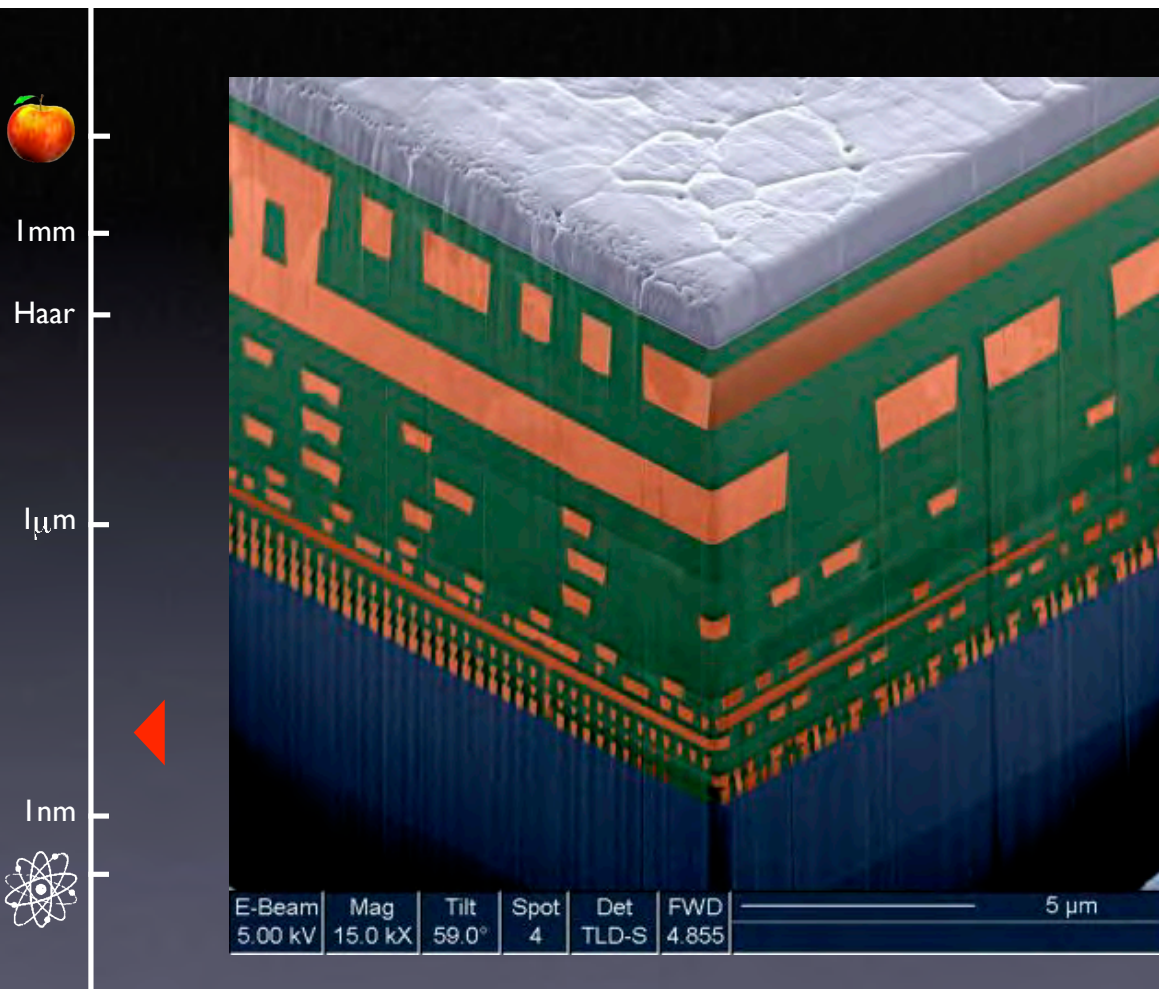
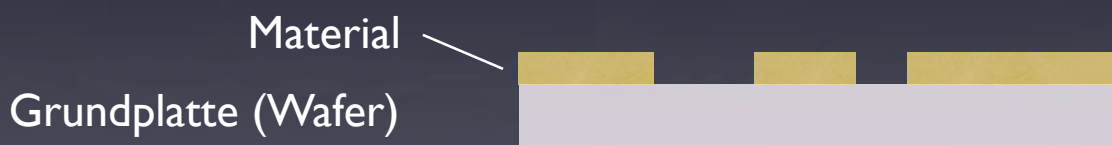
HF

KOH



HF Bad

Resultat





Intel

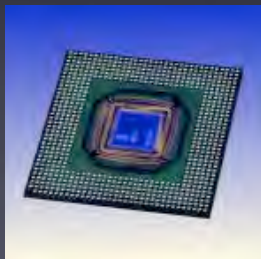
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Beispiele

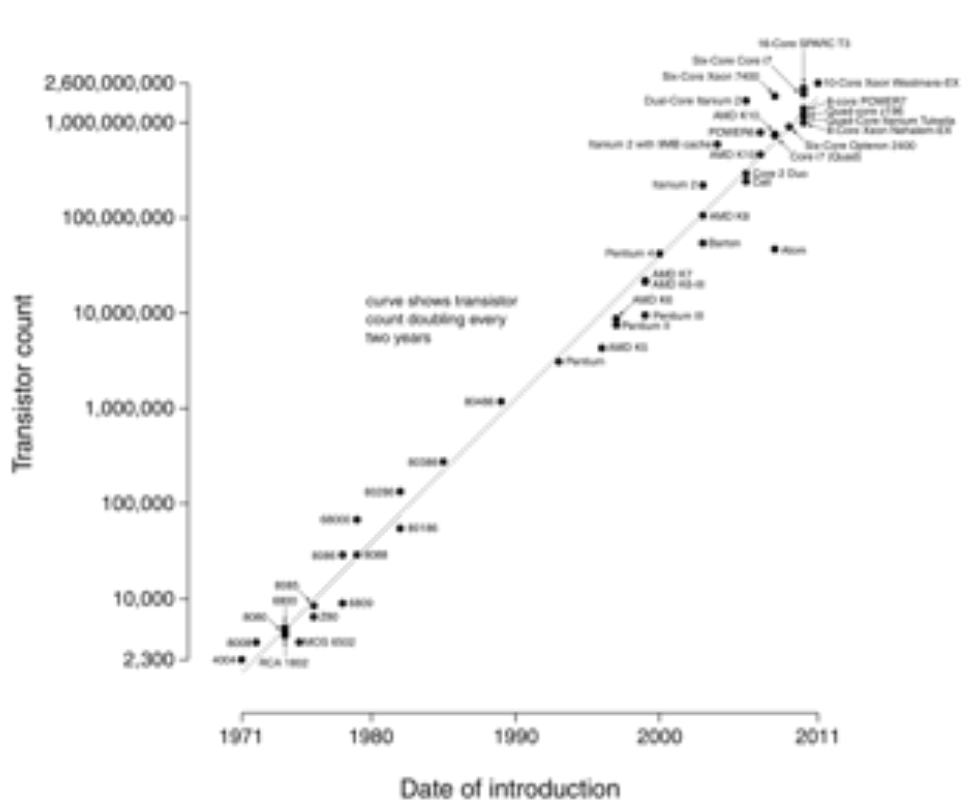
- Prozessoren
- SSD Flash Speicher

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Prozessoren



Microprocessor Transistor Counts 1971-2011 & Moore's Law



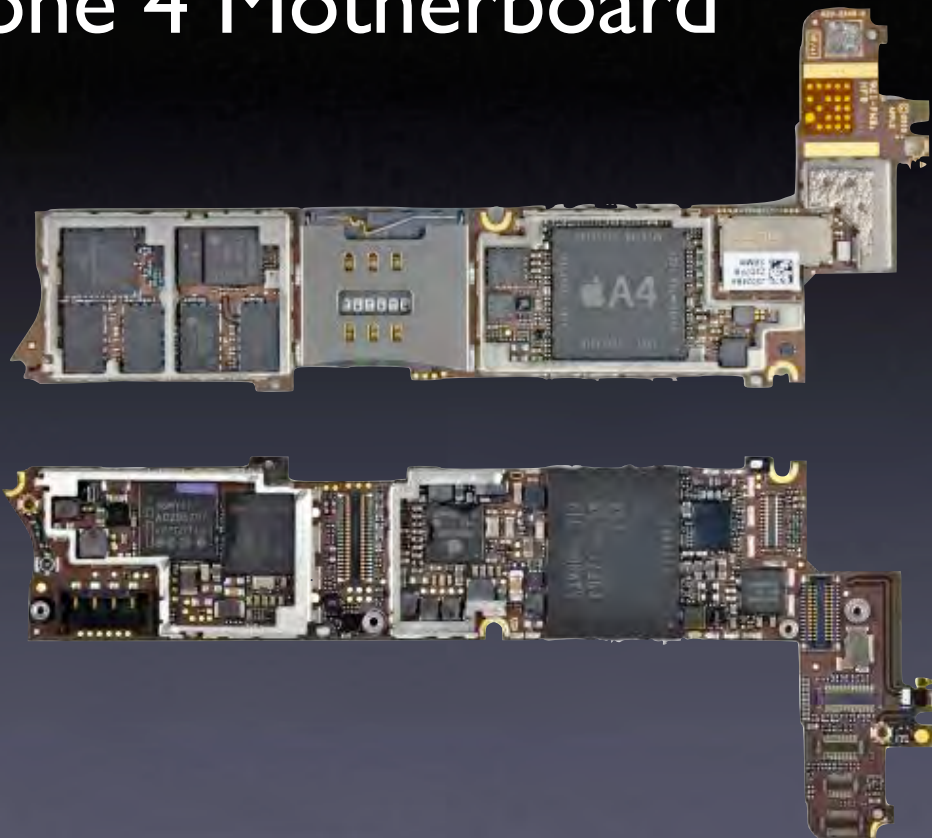
iPhone 4



Nano in der Technik

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iPhone 4 Motherboard



Nano in der Technik

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iPhone Prozessor

1mm

Haar

A6 CPU:
ARM dual core, 1.3GHz
(produziert von Samsung)

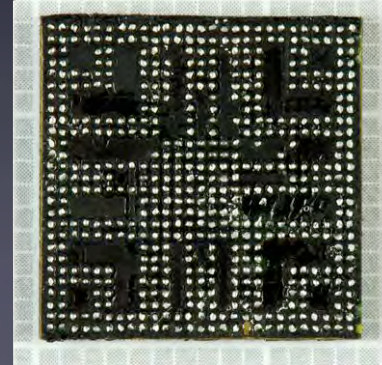
Leistungsverbrauch: 500-800 mW
32 Nanometer Prozess

1µm

Entwicklungskosten: 1 Mia \$



1nm

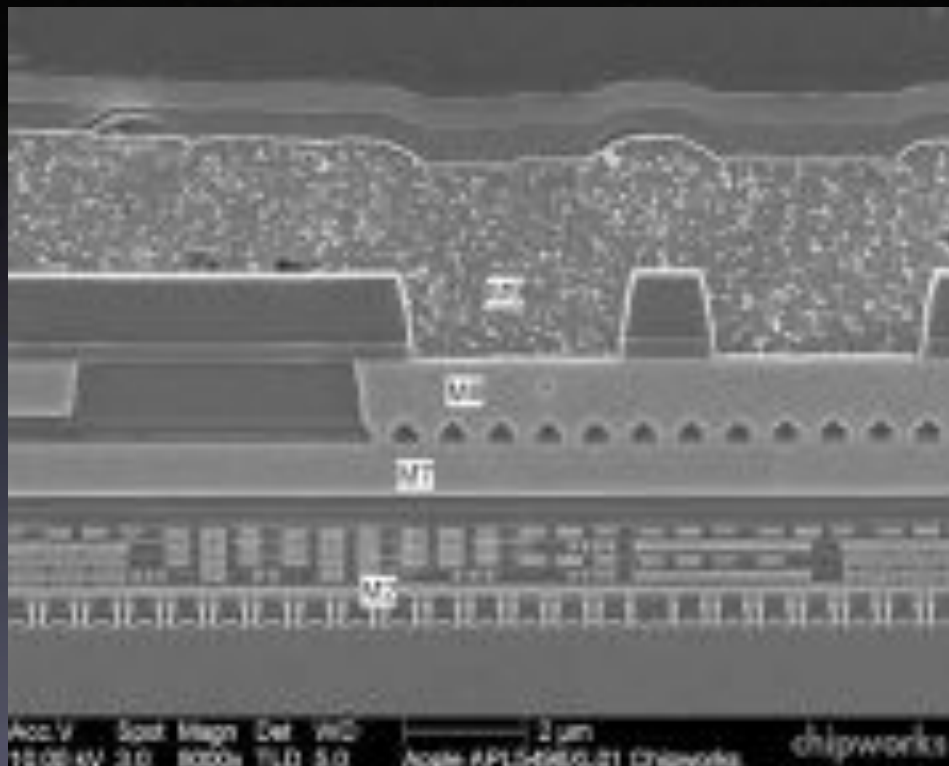


1mm

Haar

1µm

1nm



Acc.V 10.00 kV 3.0 Spot Magn Det WCD 2µm
12:00:41.00 8000x TLD 5.0 Apple APL5-666-0.21 Chipworks chipworks

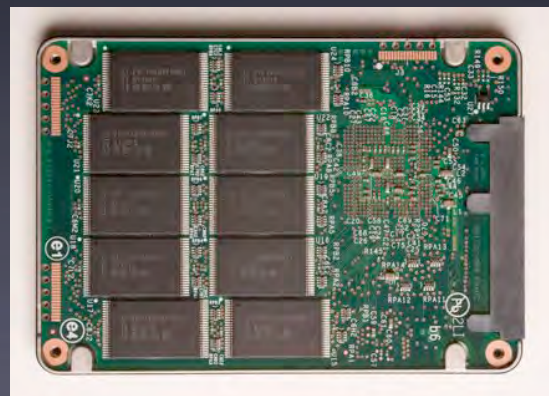


3 Chips in einem:
(System on Chip)
- 2x 512MB SRAM Module
- Prozessor



Festplatte — SSD Flash

(solide state disc)



SSD Flash Speicher



32GB \triangleq 256'000'000'000bits

\triangleq 20'000 Bücher

Alle Bücher der Stiftsbibliothek passen auf 8 chips!

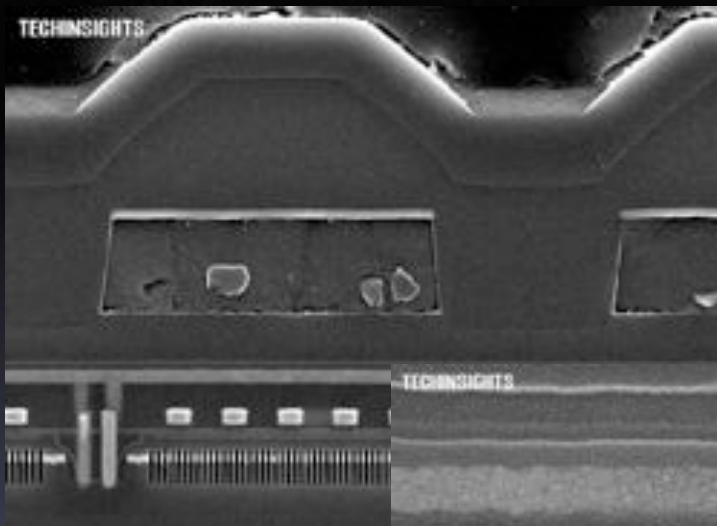


1mm

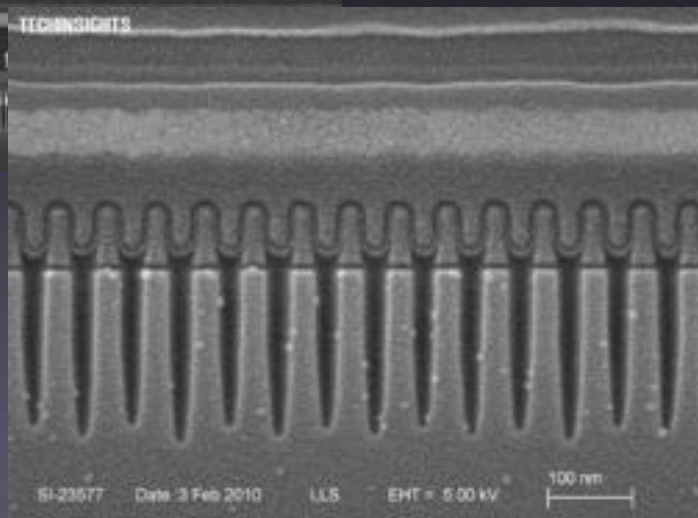
Haar

1 μ m

1nm



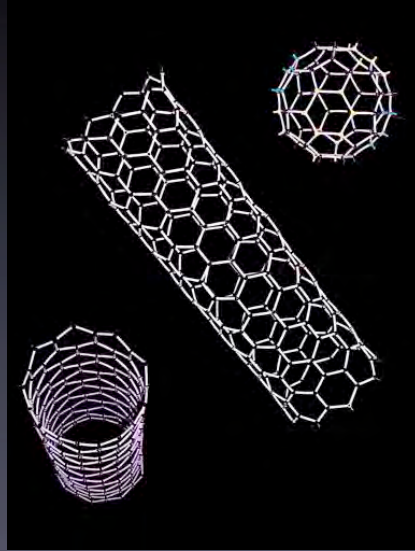
SSD Flash Speicher



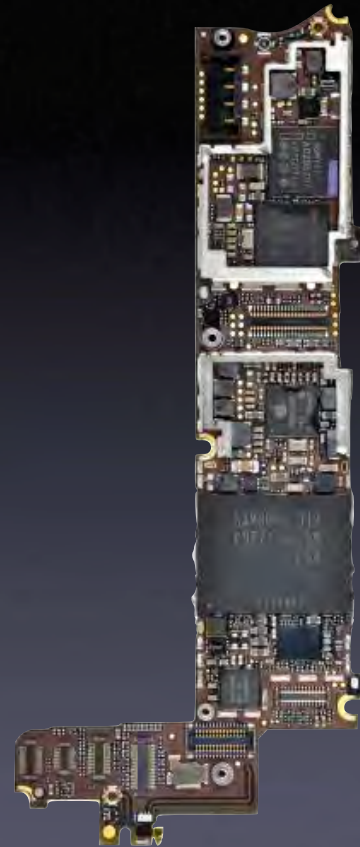
Gefahren



Lotusblume, Lotus-Effekt



Carbon Nano Tubes



Elektronik

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Danke für Ihre Aufmerksamkeit.

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