Construction

Sikafloor - Clean room requirements

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Content:

- Definitions and relevant guidelines

- The need for clean conditions

- Sources of contaminations

- Some facts about contaminations

- Summary

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Definitions & Facts

- Relevant guidelines: VDI 2083 and EN ISO 14644 „*Cleanrooms and associated controlled environments*"

- EN ISO 14644 is a valid standard in following European countries:

- Belgium	- Netherlands	- United Kingdom
- Denmark	- Luxembourg	- Czech Republic
- Germany	- Norway	- Italy
- Finland	- Austria	- adopted as ANSI/IEST/ISO 14644-1:1999 in the United States
- France	- Portugal	
- Greece	- Sweden	
- Ireland	- Switzerland	
- Iceland	- Spain	

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Definitions & Facts

→ EN ISO 14644 – part 1: *classification of air cleanliness*:

- *particle*: liquid or solid matter with diameter 0.1 µm – 5 µm

- *superfine particle*: diameter < 0.1 µm

- *macro particle*: diameter > 5 µm

- *fibre*: particle with a ratio length : width ≥ 10

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Definitions & Facts

EN ISO 14644 – part 1: *classification of air cleanliness*

Tabelle 1: Ausgewählte Partikelreinheitsklassen der Luft für Reinräume und Reine Bereiche

ISO-Klassifizierungszahl (N)	Höchstwert der Partikelkonzentrationen (Partikel je Kubikmeter Luft) gleich oder größer als die betrachteten Größen, welche nachfolgend abgebildet sind (Die Konzentrationsgrenzen sind nach Gleichung (1) in 3.2 berechnet.)					
	0,1 µm	0,2 µm	0,3 µm	0,5 µm	1 µm	5 µm
ISO-Klasse 1	10	2	—	—	—	—
ISO-Klasse 2	100	24	10	4	—	—
ISO-Klasse 3	1 000	237	102	35	8	—
ISO-Klasse 4	10 000	2 370	1 020	352	83	—
ISO-Klasse 5	100 000	23 700	10 200	3 520	832	29
ISO-Klasse 6	1 000 000	237 000	102 000	35 200	8 320	293
ISO-Klasse 7	—	—	—	352 000	83 200	2 930
ISO-Klasse 8	—	—	—	3 520 000	832 000	29 300
ISO-Klasse 9	—	—	—	35 200 000	8 320 000	293 000

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Definitions & Facts

→ EN ISO 14644 – part 8: *classification of airborne molecular contaminations*

AMC are (chemical) species in gaseous or vaporous state in the atmosphere of a cleanroom, which may have a damaging effect on product, process or equipment

grouping of similar substances in so-called contaminant families (e.g. acids, bases, oxidants, condensable or organic contaminants...)

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Definitions & Facts

ISO-AMC- classification

Tabelle 1 — ISO-AMC-Klassen

ISO-AMC-Klasse	Konzentration g/m³	Konzentration µg/m³	Konzentration ng/m³
0	10^0	10^6 (1 000 000)	10^9 (1 000 000 000)
− 1	10^{-1}	10^5 (100 000)	10^8 (100 000 000)
− 2	10^{-2}	10^4 (10 000)	10^7 (10 000 000)
− 3	10^{-3}	10^3 (1 000)	10^6 (1 000 000)
− 4	10^{-4}	10^2 (100)	10^5 (100 000)
− 5	10^{-5}	10^1 (10)	10^4 (10 000)
− 6	10^{-6}	10^0 (1)	10^3 (1 000)
− 7	10^{-7}	10^{-1} (0,1)	10^2 (100)
− 8	10^{-8}	10^{-2} (0,01)	10^1 (10)
− 9	10^{-9}	10^{-3} (0,001)	10^0 (1)
− 10	10^{-10}	10^{-4} (0,000 1)	10^{-1} (0,1)
− 11	10^{-11}	10^{-5} (0,000 01)	10^{-2} (0,01)
− 12	10^{-12}	10^{-6} (0,000 001)	10^{-3} (0,001)

example: c(ammonia) = 10^{-6} g/m³ $\rightarrow$ ISO-AMC-class −6 (NH_3)

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The need for clean conditions

Who has to produce under *clean* conditions?

- semiconductors

- aerospace

- microelectronics

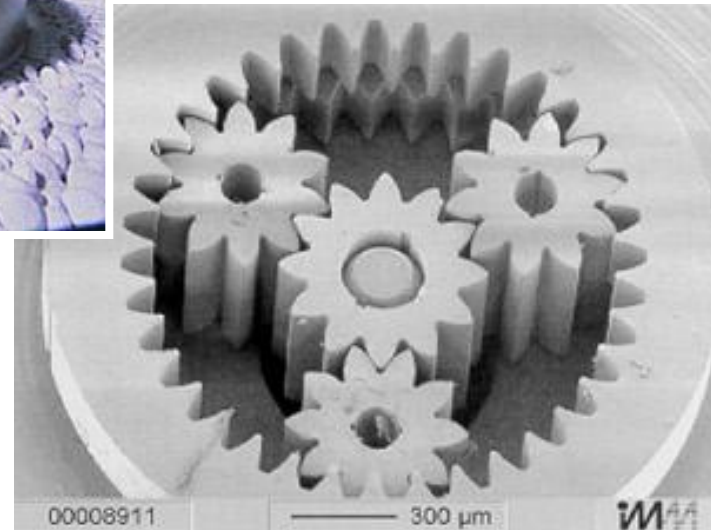- Pharmaceuticals

- medical devices

- Healthcare

- Food

.... the only difference is the *level* of clean conditions

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The need for clean conditions

....some examples

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The need for clean conditions

Why to produce under *clean* conditions?

.... because of preventing damages!

**NASA Hubble
Space Telescope**

**not performing as designed
because of a particle < 0.5 µm**

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The need for clean conditions

Requirements of cleanliness of products are increasing steadily:

- **Semiconductor and electronic industry:**
  decrease of structure width

- **Industry**:
  abandonment of preservatives

- **Pharmaceutical industry:**
  pureness of active pharmaceutical ingredients
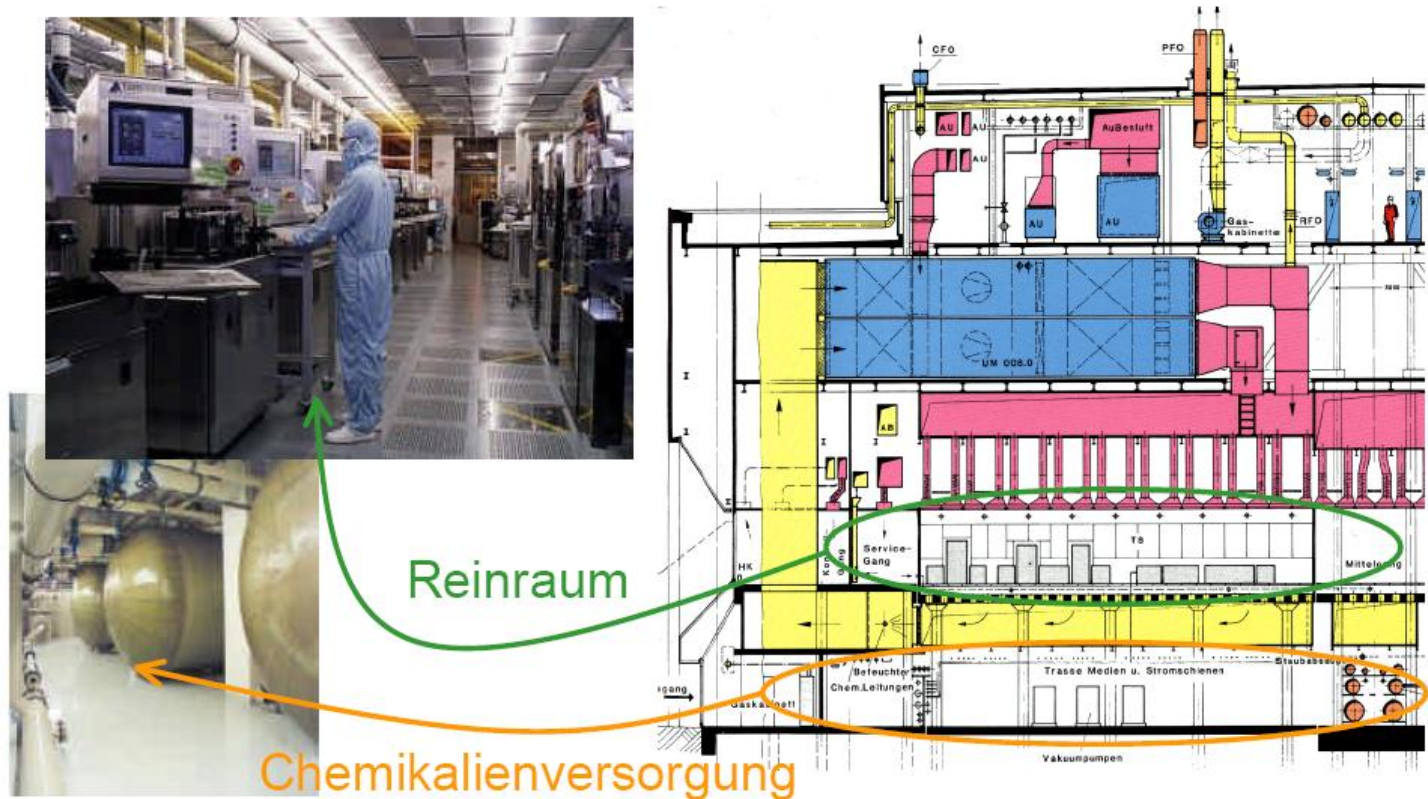
Manufacturer's needs:

- Cutting of production costs

- Higher process reliability

- Less rejects due to defects

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The need for clean conditions

... cross-section of a cleanroom in semiconductor's industry

Reinraum

Chemikalienversorgung

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The need for clean conditions

... *chemical cocktail* in chip manufacturing

Wafer Epitaxial Processing
Trichlorosiliane, Silicon, Tetrachloride, Hydrogen, Diborane, Phosphine

Oxidation Layering
High Purity Oxygen & Nitrogen

Photoresisting Coating
Photoresists

Chemical Mechanical Planarization (CMP)
Slurries and Pads

Stepper Exposure

Develop & Bake
Acids and/or Bases

Ashing

Etching
Acids, Bases & Caustics

Metal Etch
Nitrogen, Chlorine, Boron Trichloride, Carbon Tetrafluoride, Silicon Tetrafluoride

Metal Deposition

Copper Deposition
Electroplating Solutions

Chemical Vapor Deposition (CVD)
Nitrogen, Hydrogen, NF_3, Ammonia, Oxygen, Silanes

Spin Rinse Dry

Ion Implant

Probe Test & Die Cut

Wire Bonding

Packaging
Ceramics, Epoxies, Silicones, Other Polymers (polyimides)

Quelle: SalomonSmithBarney, Electronic

Any contamination disturbing this complex process has to be avoided!

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(1) <u>People</u>

- hair, skin flakes, spittle

- cosmetics and perfume

- Attitude:

people activity	particles per minute (>0.3 microns)
motionless (standing or seated)	100,000
walking about 2 mph	5,000,000
walking about 3.5 mph	7,000,000
walking about 5 mph	10,000,000
horseplay	100,000,000

(2) <u>Facilities</u>

- walls, floors, ceilings
- air conditioning debris
- cleaning chemicals

- paints and coatings
- room air and vapours

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Sources of contaminations

(3) <u>Tool generated</u>

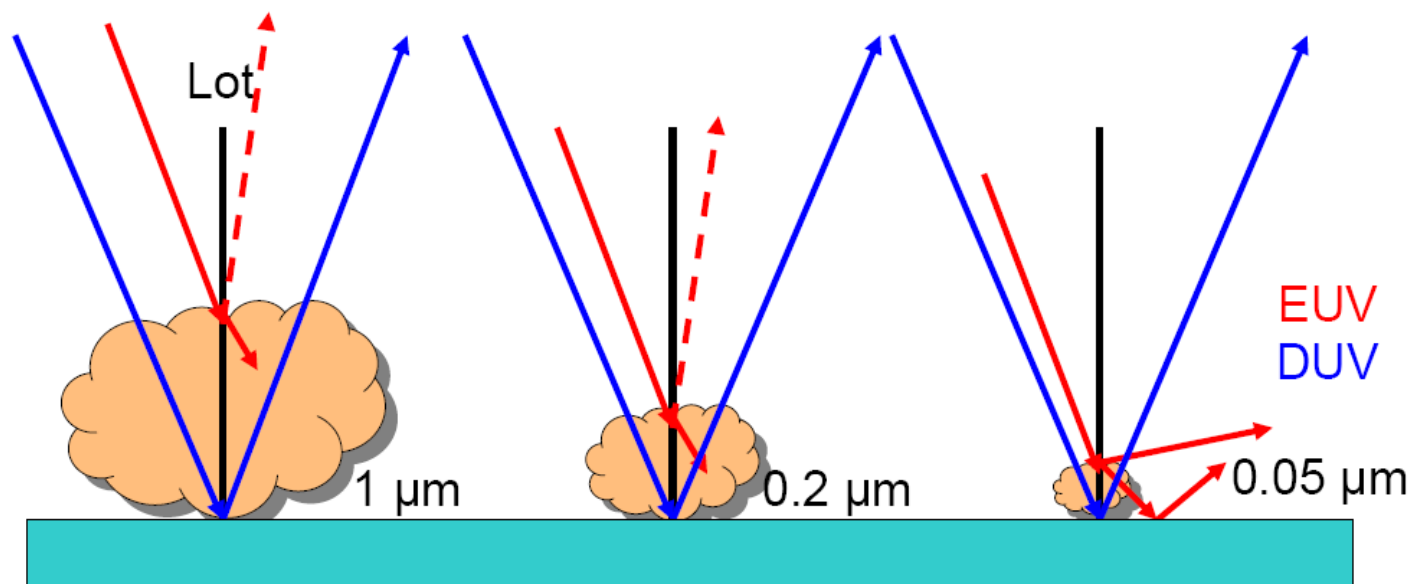- friction and wear particles

- Lubricants

(4) <u>Product generated</u>

- silicon particles

- quartz flakes

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Some facts about contaminations

... *Particles on lithographic process* in chip manufacturing

lithography at	1.0 µm particle	0.2 µm particle	0.05 µm particle
248 nm (DUV)	loss of contrast scattering	loss of contrast	no effect
13 nm (EUV)	loss of contrast absorption	analogue 1.0 µm	loss of transmission

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Some facts about contaminations

... for comparison the diameter of a human hair is about
50 to *1000* times bigger than those particles

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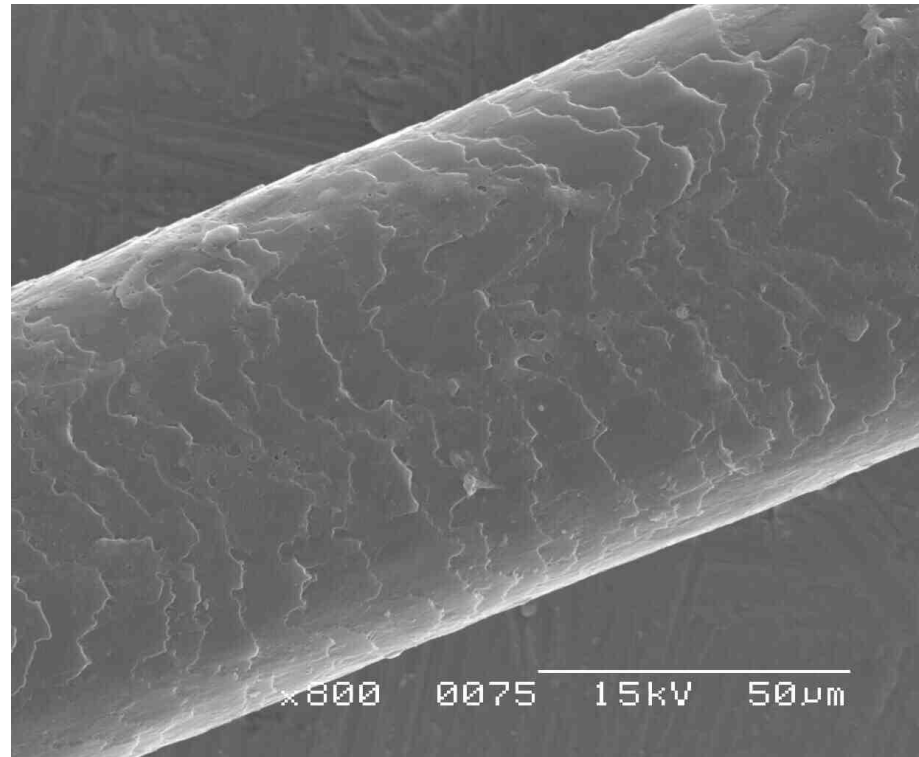
Some facts about contaminations

Analogue to the particle contaminations each sector of industry has its own acceptance criteria for airborne molecular contaminations

	tolerable organic layer (AMC) on substrate [nm]
lithography	< 0.1
hard discs	< 1
aerospace industry	< 4
precision mechanics	about 10
pharma / food	no visible contaminations

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Summary

- Many sectors of industry have needs for *clean* production

- The requirements of cleanliness depend on products and processes

- These requirements have to be defined by the process owner

- Main goals of clean production are higher process reliability and less rejects due to defects

- Tendency to increasing requirements in various sectors of industry

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Thank you for your attention

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