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# FTD Cleanroom

## overview, facts and plans

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Bonn

Dr. Yevgen Bilevych

2022

## cleanroom

room within which the number concentration of airborne particles (solid or liquid object suspended in air, viable or non-viable, sized between 1 nm and 100 µm) is controlled and classified, and which is designed, constructed and operated in a manner to control the introduction, generation and retention of particles inside the room

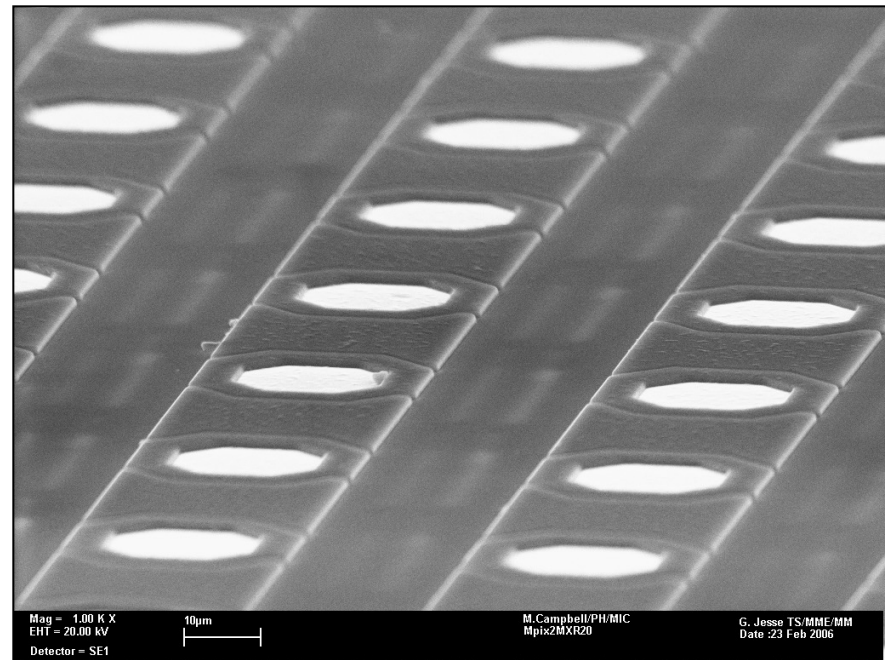
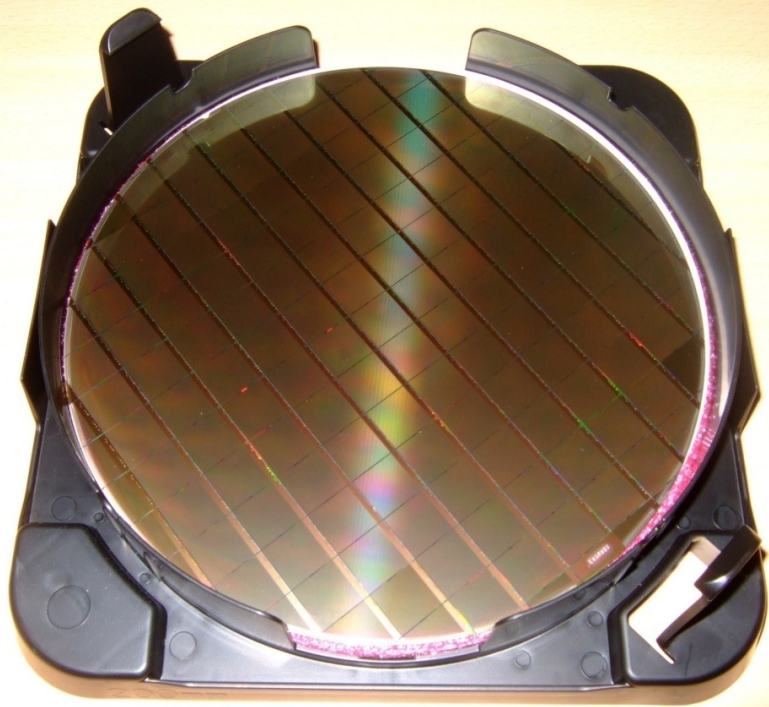
Note 1 to entry: The class of airborne particles concentration (number of individual particles per unit volume of air) is specified.

Note 2 to entry: Levels of other cleanliness attributes such as chemical, viable or nanoscale concentrations in the air, and also surface cleanliness in terms of particle, nanoscale, chemical and viable concentrations might also be specified and controlled.

Note 3 to entry: Other relevant physical parameters might also be controlled as required, e.g. temperature, humidity, pressure, vibration and electrostatic.

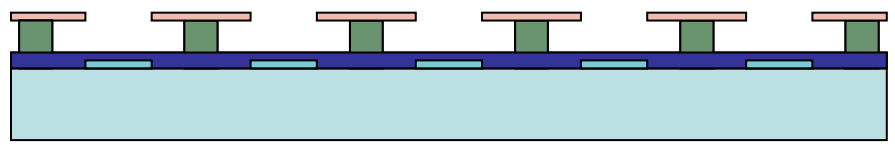
**Table 1 — ISO Classes of air cleanliness by particle concentration**

ISO Class number (N)	Maximum allowable concentrations (particles/m <sup>3</sup> ) for particles equal to and greater than the considered sizes, shown below <sup>a</sup>					
	0,1 µm	0,2 µm	0,3 µm	0,5 µm	1 µm	5 µm
1	10 <sup>b</sup>	d	d	d	d	e
2	100	24 <sup>b</sup>	10 <sup>b</sup>	d	d	e
3	1 000	237	102	35 <sup>b</sup>	d	e
4	10 000	2 370	1 020	352	83 <sup>b</sup>	e
5	100 000	23 700	10 200	3 520	832	d, e, f
6	1 000 000	237 000	102 000	35 200	8 320	293
7	c	c	c	352 000	83 200	2 930
8	c	c	c	3 520 000	832 000	29 300
9g	c	c	c	35 200 000	8 320 000	293 000

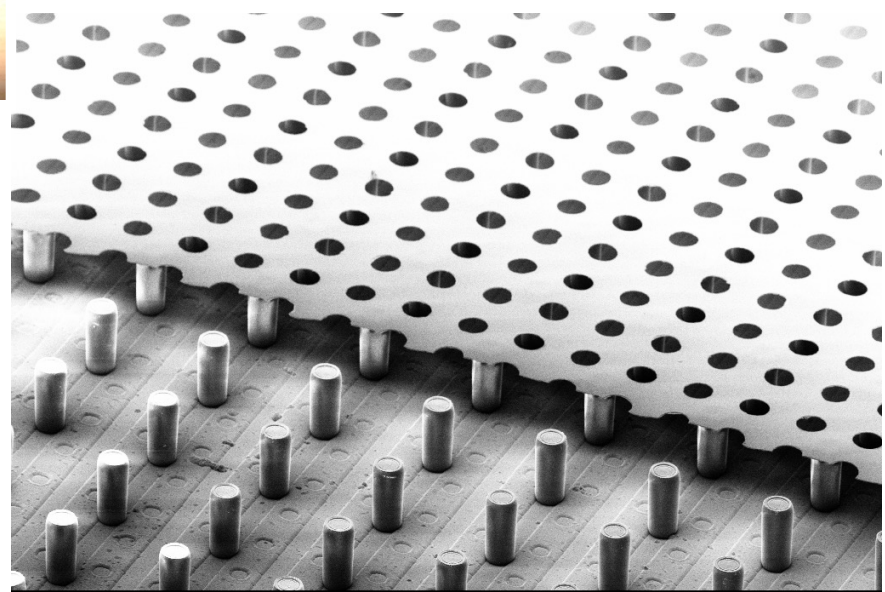


Mag = 1.00 K X      EHT = 20.00 kV      Detector = SE1      10µm  
 M.Campbell/PH/MIC      G. Jesso TS/MME/MM      Date :23 Feb 2006

## TimePix / InGrid



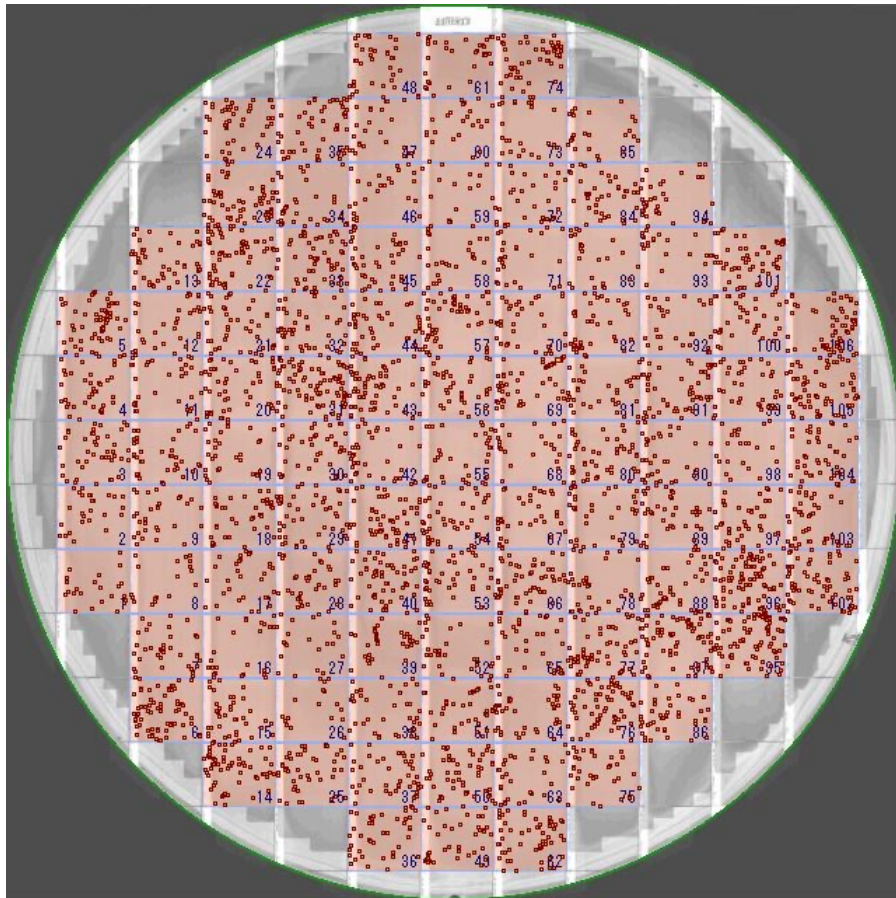
Chip      Pixel pad      Protection layer      SU-8 column      aluminum



Mag = 150 X      EHT = 5.00 kV      Stage at T = 63.0 °      Fraunhofer IZM  
 WD = 11.4 mm      Tilt Corr. = On      K. Kaletta  
 Detector = SE2      Aperture Size = 30.00 µm      FIB Imaging = SEM      Date :26 May 2013

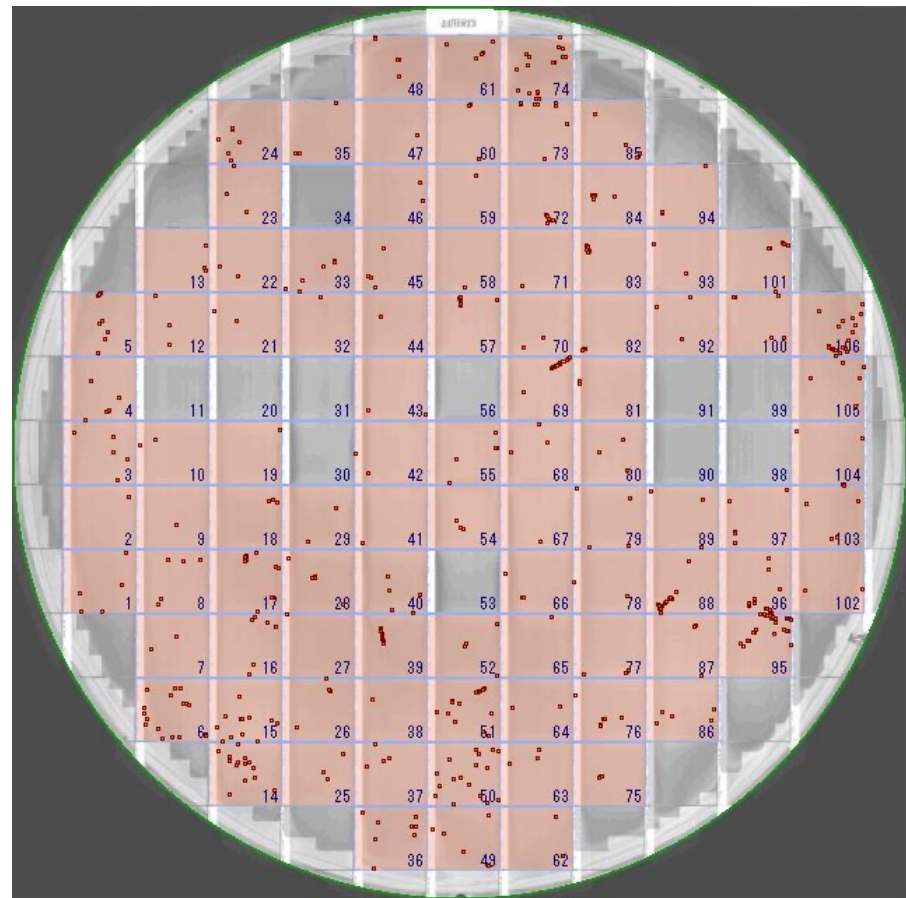
# TimePix wafer surface defecs inspection

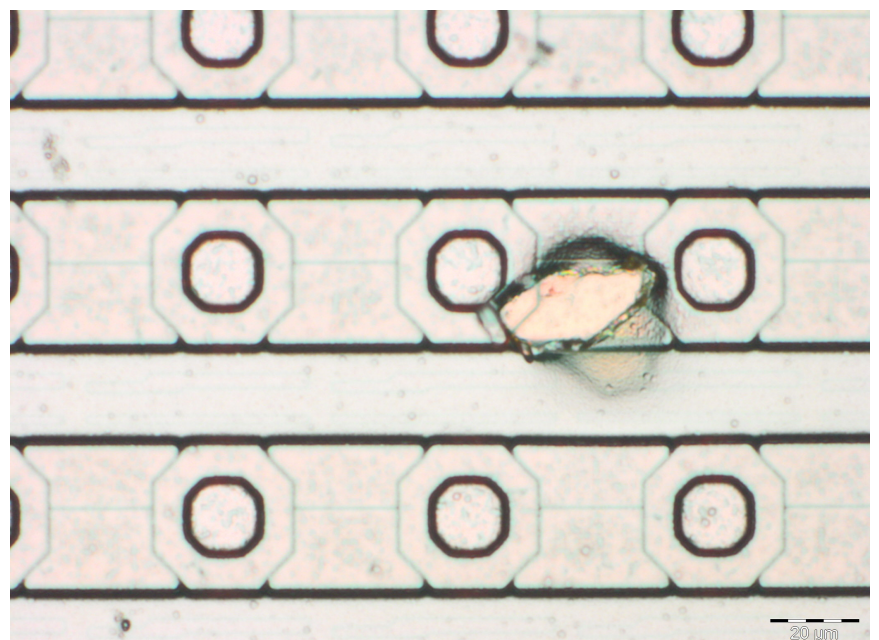
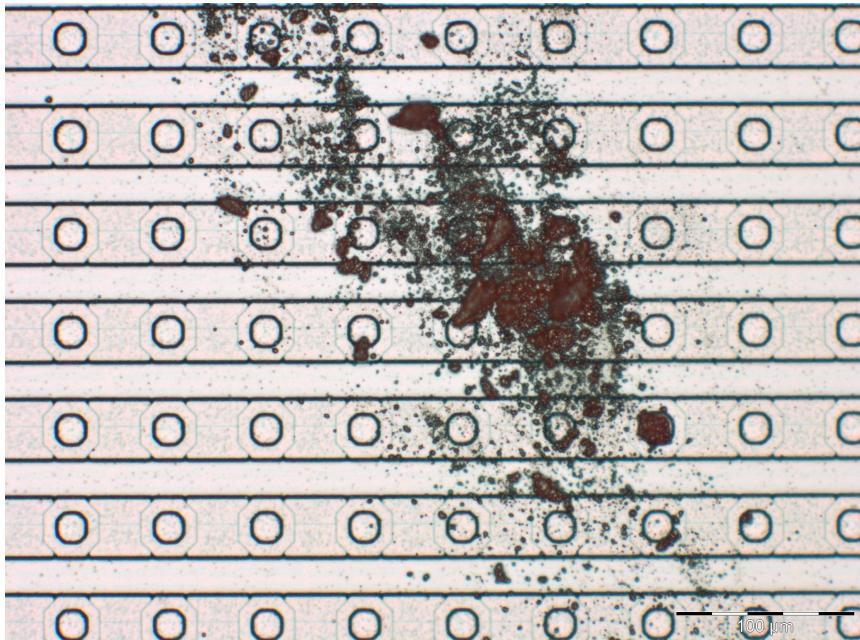
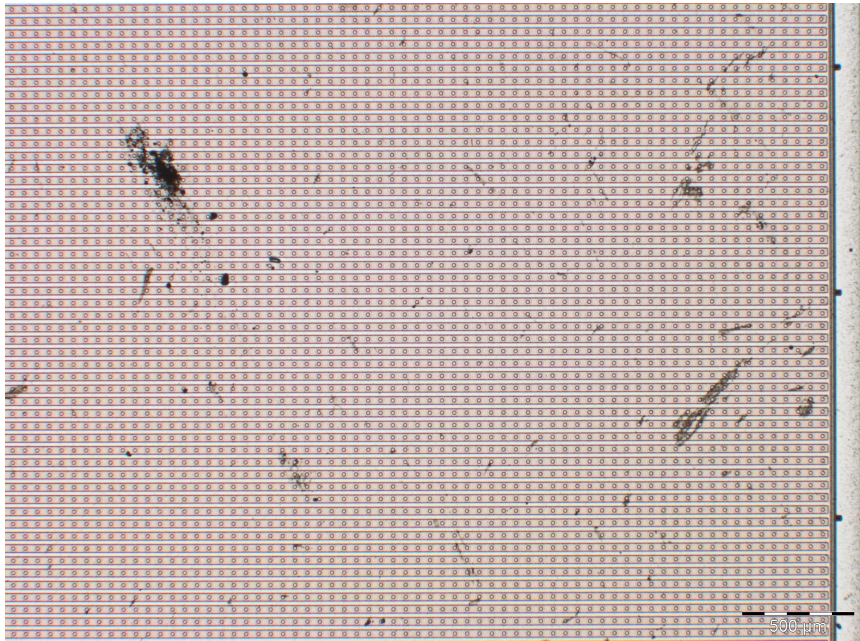
Initial

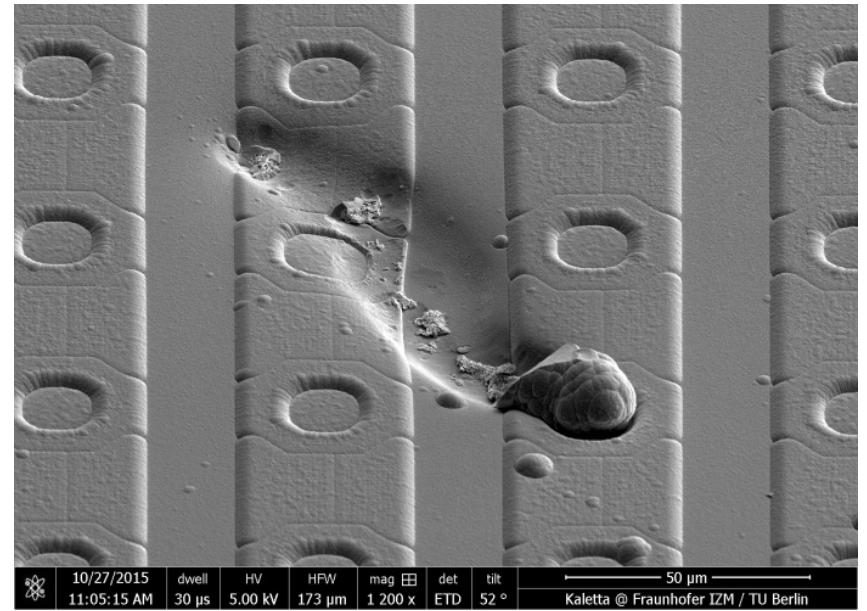
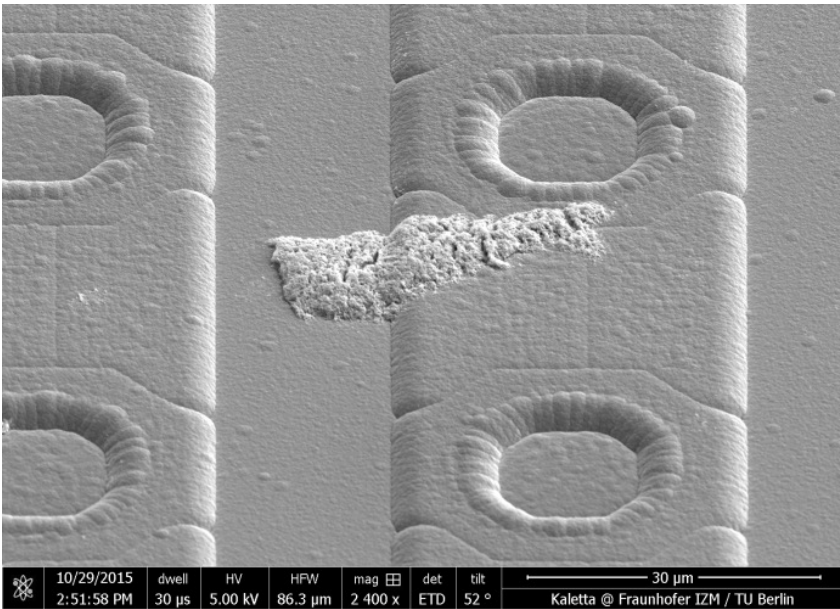
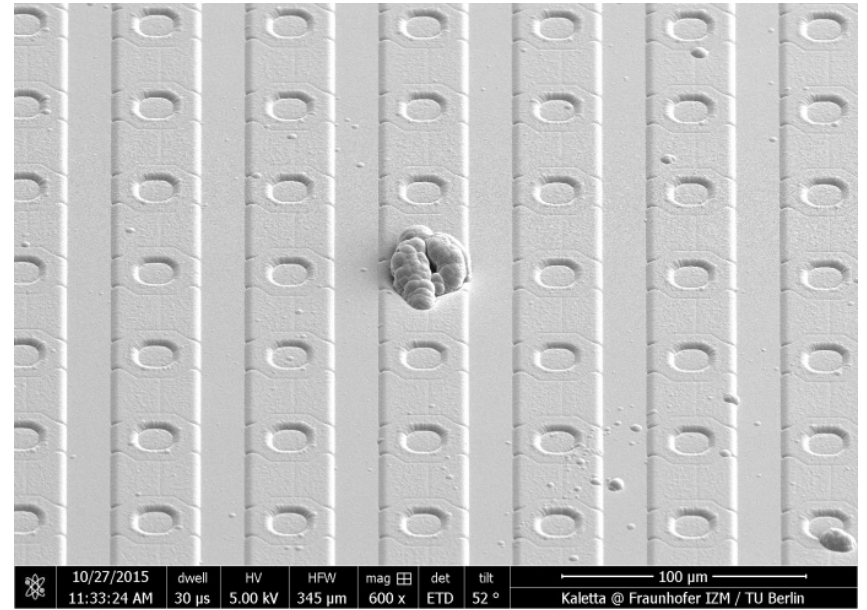
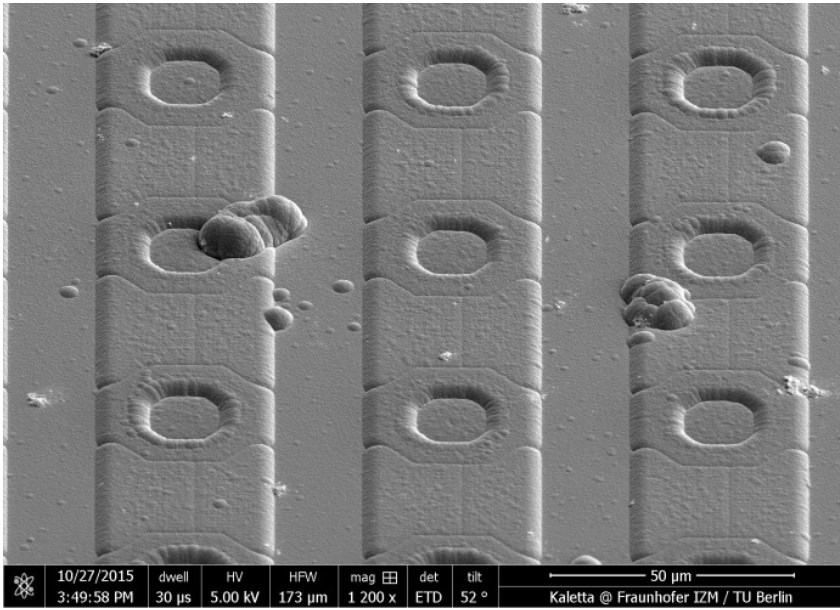


ER5N2CX

Cleaned







# FTD Cleanroom Uni-Bonn layout

Cleanroom area – about 360 m<sup>2</sup>

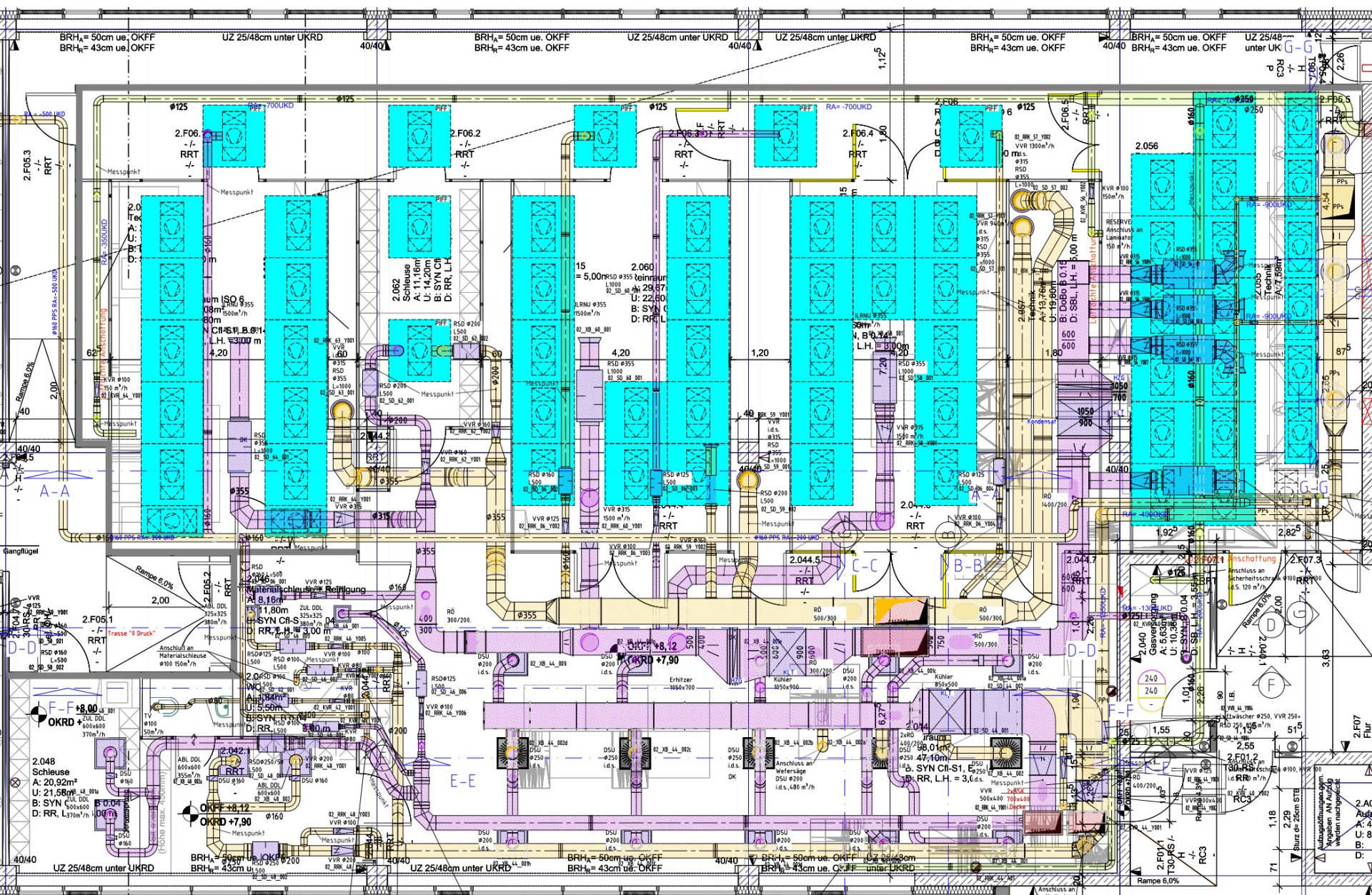
5 Labs – ISO-7, 3 ISO-6, ISO-5







# FTD Cleanroom Uni-Bonn Plenum layout



# Cleanroom monitor

- RLT 1 Reinraum
- RLT 2 Allgemein
- RLT 3 Messräume
- RLT 3.1 Kristallager
- Wasserrähler 3.OG
- RLT04 Abluf1 Labore
- RLT 5 Gasflaschenschrank
- RLT 6 Gasflaschenschrank
- RLT 8 Laborabzüge

- Druckluftzeugung
- TH 1 Freie Kühlung
- TH 2 Freie Kühlung

- Kälteerzeugung
- Verteiler Kälte
- Rückkühlwerke
- Prozesskälte Labor

- Wärmeerzeugung
- Verteiler Wärme
- Betonkerntemperierung

3.OG RRK 05 Daten

3.OG RRK 13

3.OG RRK 17

3.OG RRK 19

3.OG RRK 31

3.OG RRK 21

2.OG RRK 05 Daten

2.OG RRK 50

2.OG RRK 52

2.OG RRK 54

2.OG RRK 66

2.OG RRK 68

2.OG RRK 70

Bereich Reinraum

2.OG RRK 31

1.OG RRK 05 Daten

1.OG RRK 29

1.OG RRK 32

1.OG RRK 34

1.OG RRK 36

1.OG RRK 37

1.OG RRK 39

1.OG RRK 41

1.OG RRK 43

1.OG RRK 45

1.OG RRK 31

EG RRK 05 Daten

EG RRK 40

EG RRK 42

EG RRK 44

EG RRK 46

EG RRK 50

EG RRK 52

EG RRK 54

EG RRK 56

EG RRK 58

EG RRK 31

U1 RRK 05

U1 RRK 41

U1 RRK 42

U1 RRK 44

U1 RRK 45

U1 RRK 46

U1 RRK 47

U1 RRK 49

U1 RRK 51

U1 RRK 53

U1 RRK 55

U1 RRK 56

U1 RRK 57

U1 RRK 59

U1 RRK 61

U1 RRK 63

U1 RRK 64

U1 RRK 65

U1 RRK 43

U1 RRK 45

U1 RRK 47

U1 RRK 49

U1 RRK 51

U1 RRK 53

U1 RRK 55

U1 RRK 57

U1 RRK 59

U1 RRK 61

U1 RRK 63

U1 RRK 65

U2 RRK 01 Tiefenlabor

U2 RRK 36 Daten

U2 RRK 34 Aufzugsmasch.

U2 RRK Flur 01

U2 RRK Flur 02

Technologie für intelligente Gebäude!

## Uni Bonn TZD-Detektorphysik

Tag : 81  
kw : 12  
19:00  
22.03.2022

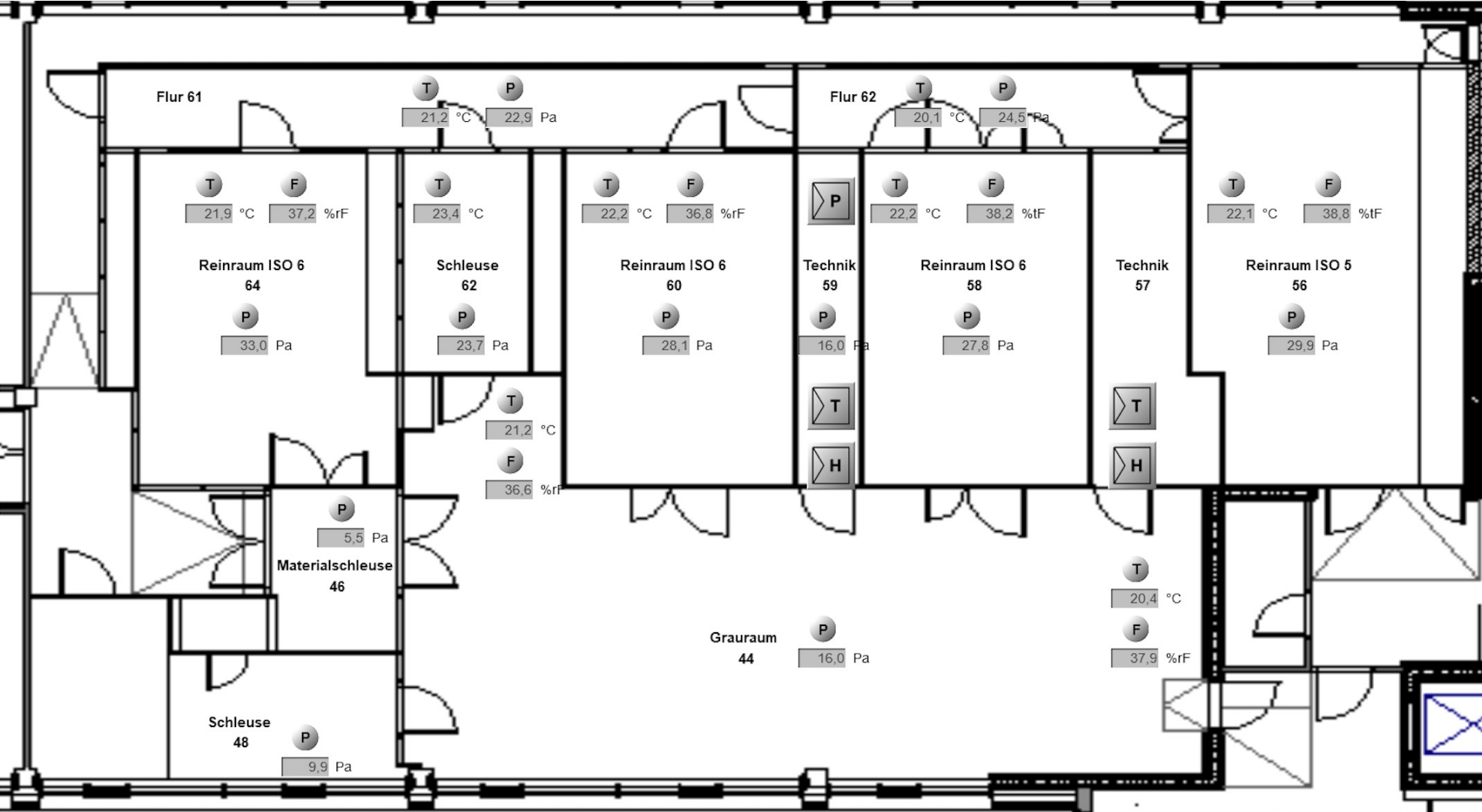
MO DI MI DO FR SA SO

Date
2022-03-22 16:41:22
2022-03-18 22:50:08
2022-03-17 10:45:20
2022-02-23 08:17:05

Message	Controller
Störung Enthaftungsanlage Umkehrosmose Sto	01: ISP04
Störung Flaschenstation Stoerung 2 (Aussenbere	01: ISP04
Warnung Betriebsrückmeldung vom Befeuchter fe	01: ISP01.3
Störung SM RK Tec BSK Controller SSM	01: ISP01.1

Controller group	OPENWeb
ISP04 Meldungen	SvBHe9ZEph
ISP04 Meldungen	SvBHe9ZEph
ISP01.3 RLT Labore	SvBHe9ZEph
ISP01.1 RLT Reinraum	SvBHe9ZEph





Flur 61

Flur 62

T 21,9 °C F 37,2 %rF

T 23,4 °C

T 22,2 °C F 36,8 %rF

P 16,0 Pa T 22,2 °C F 38,2 %rF

T 22,1 °C F 38,8 %rF

Reinraum ISO 6  
64

Schleuse  
62

Reinraum ISO 6  
60

Technik  
59

Reinraum ISO 6  
58

Technik  
57

Reinraum ISO 5  
56

P 33,0 Pa

P 23,7 Pa

P 28,1 Pa

P 16,0 Pa

P 27,8 Pa

P 29,9 Pa

T 21,2 °C

F 36,6 %rF

P 5,5 Pa

Materialschleuse  
46

Grauraum  
44 P 16,0 Pa

T 20,4 °C

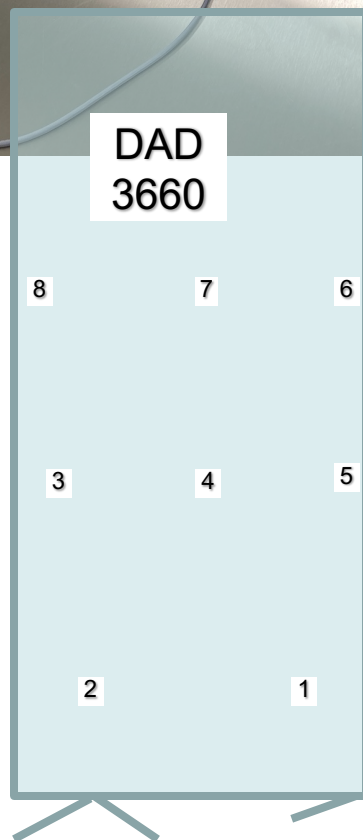
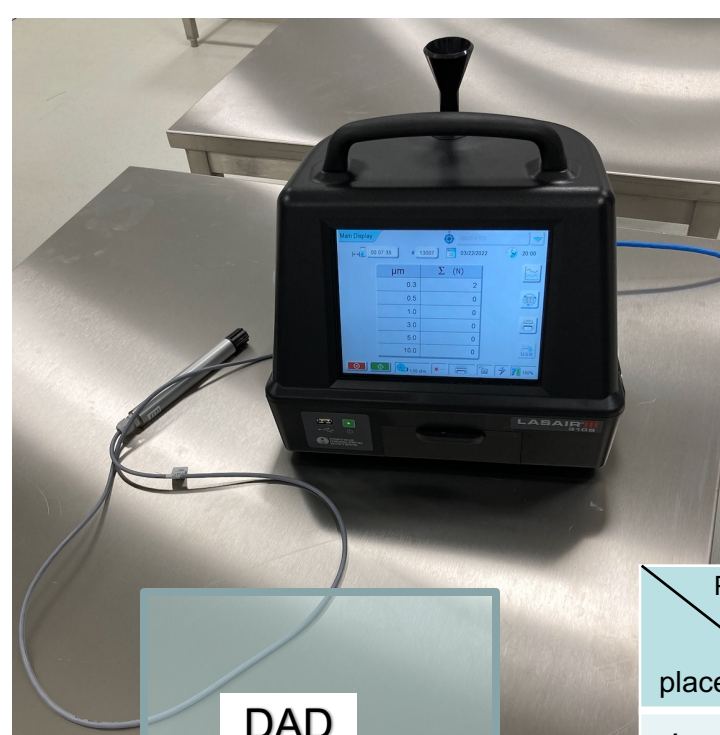
F 37,9 %rF

Schleuse  
48 P 9,9 Pa



## ISO-7 lab

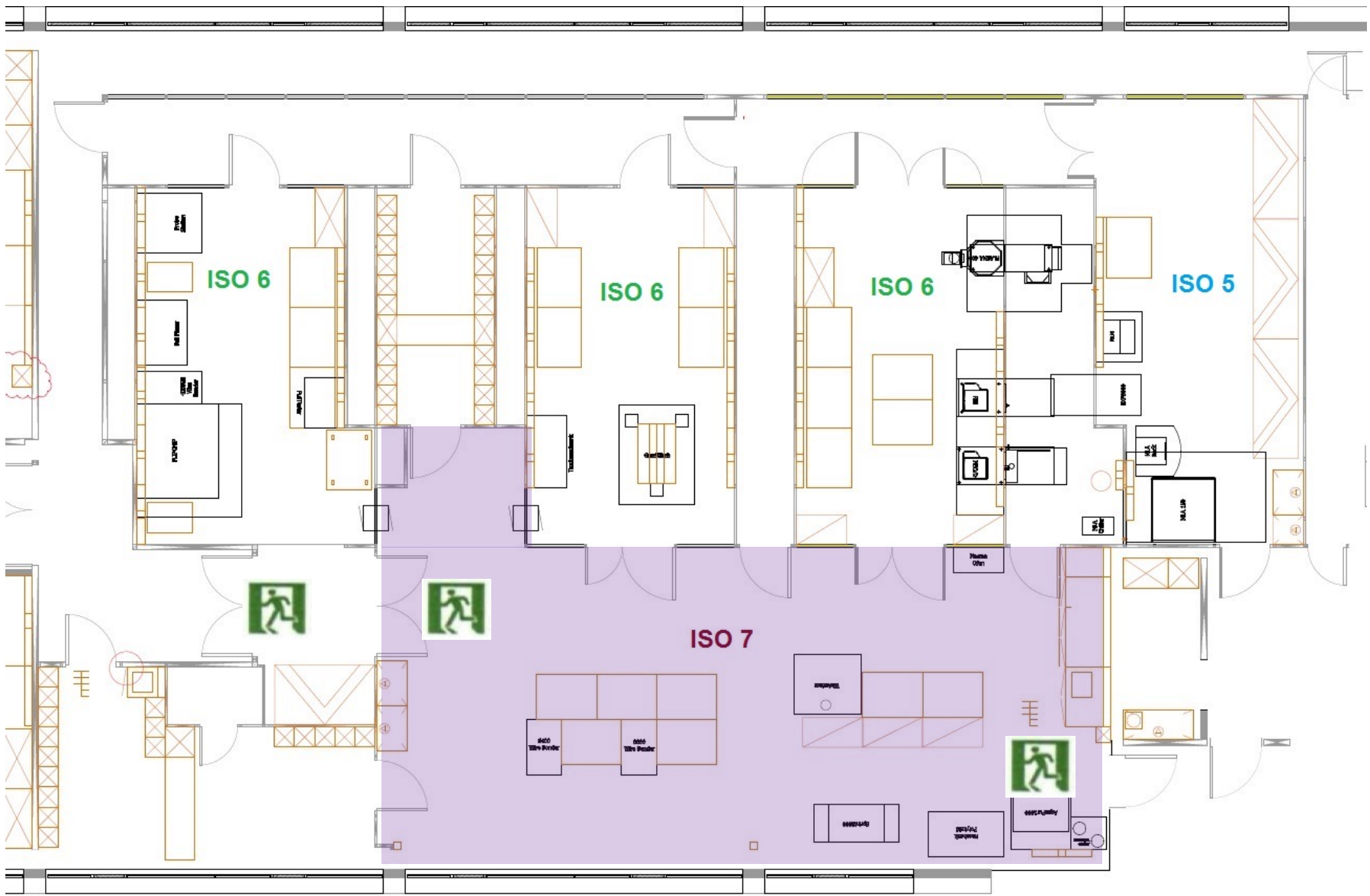
### particles amount monitoring

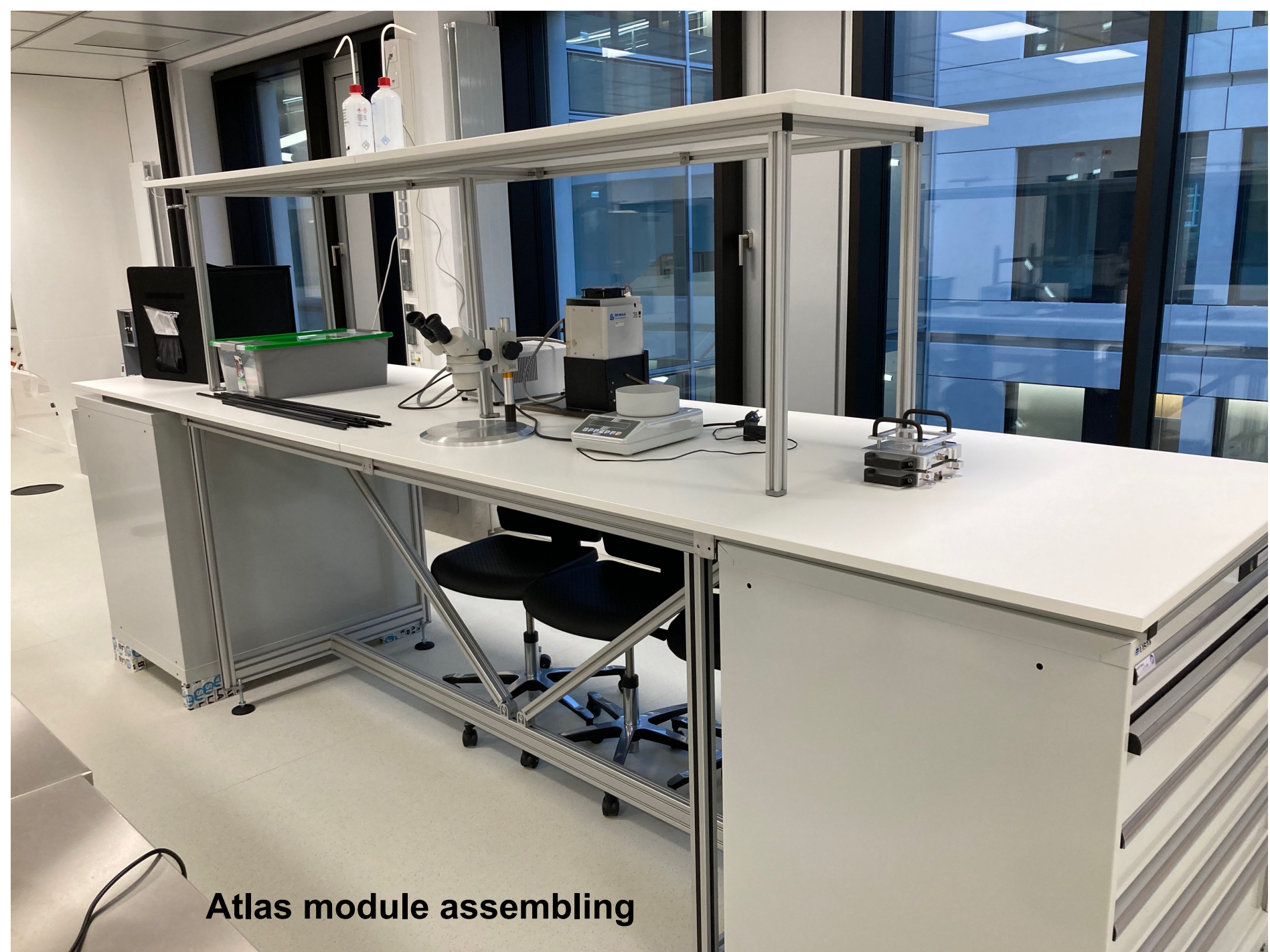


Particles size, $\mu$	0,3	0,5	1	3	5	10
place						
1	998	659	438	201	118	63
2	959	644	407	186	130	72
3	827	541	361	165	100	41
4	408	271	178	79	43	24
5	703	465	314	100	63	24
6	472	289	202	99	68	39
7	605	384	261	118	64	34
8	755	514	359	183	117	67

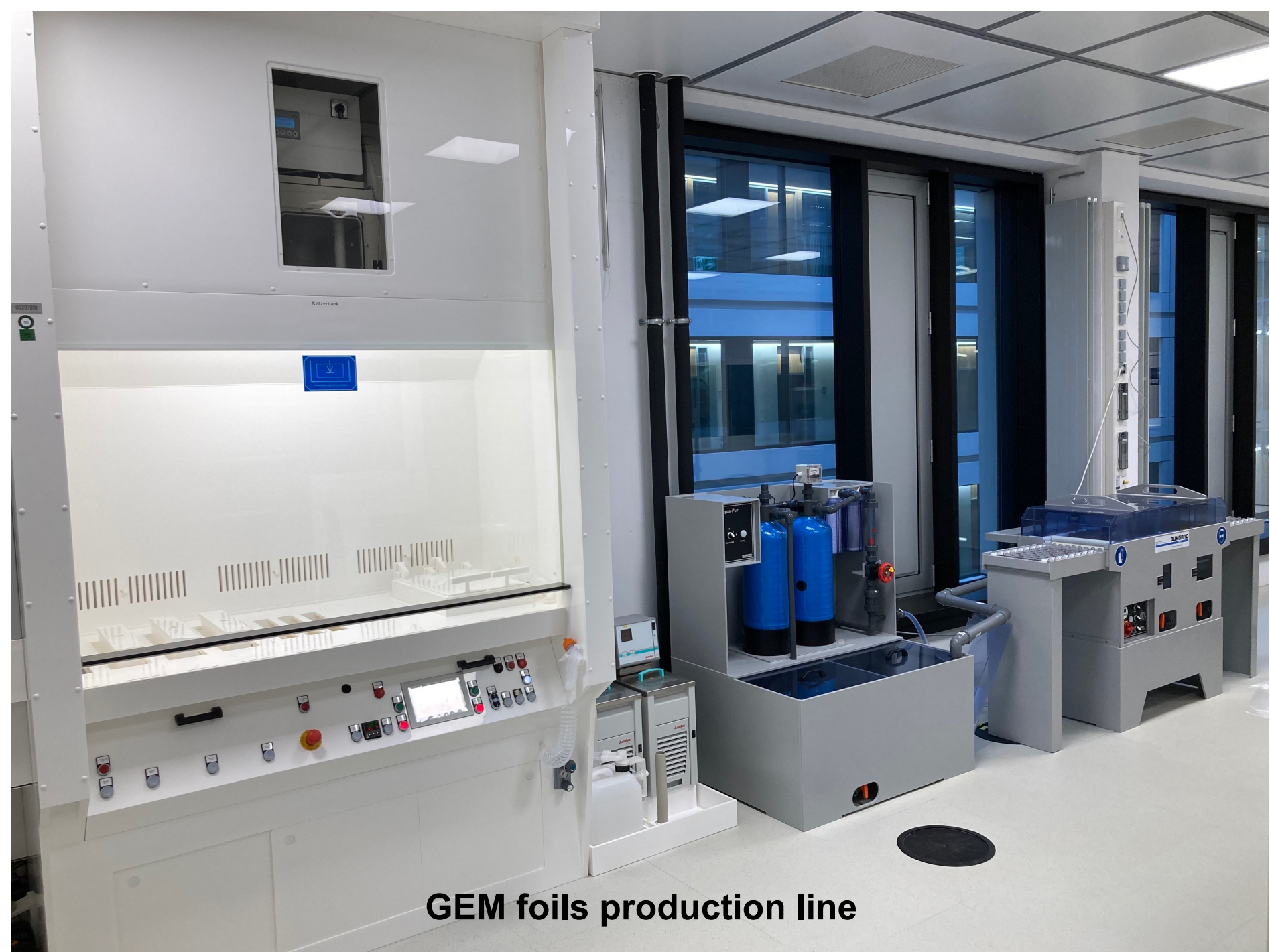


# ISO-7 room Room 2.044





**Atlas module assembling**



**GEM foils production line**



# Dicing Saw DAD 3660

# Air, vacuum, N<sub>2</sub> supply



## Technical Area



**AquaLab  
water purification system**

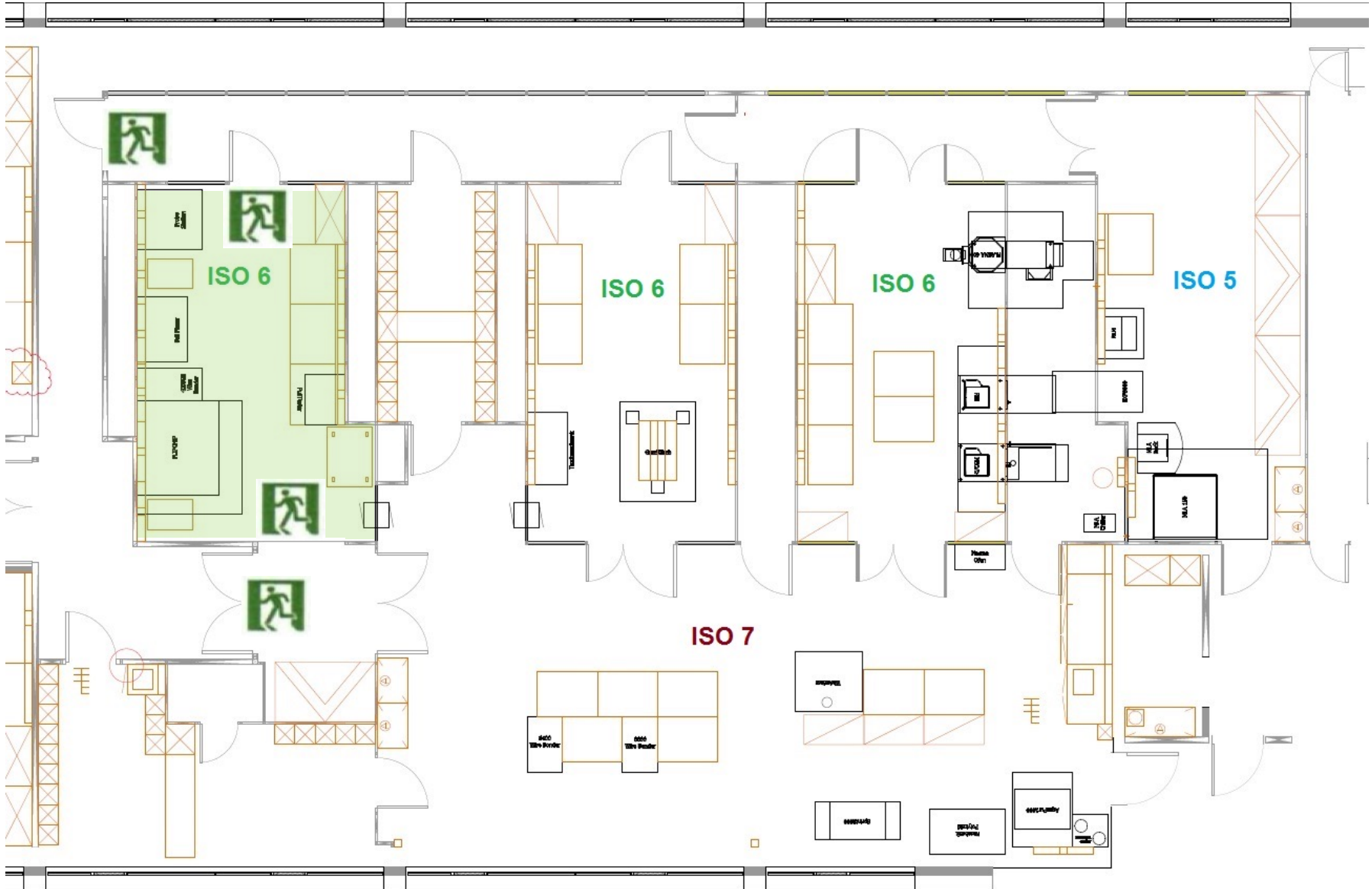
## Gas lines



# FTD cleanroom Gas storage room



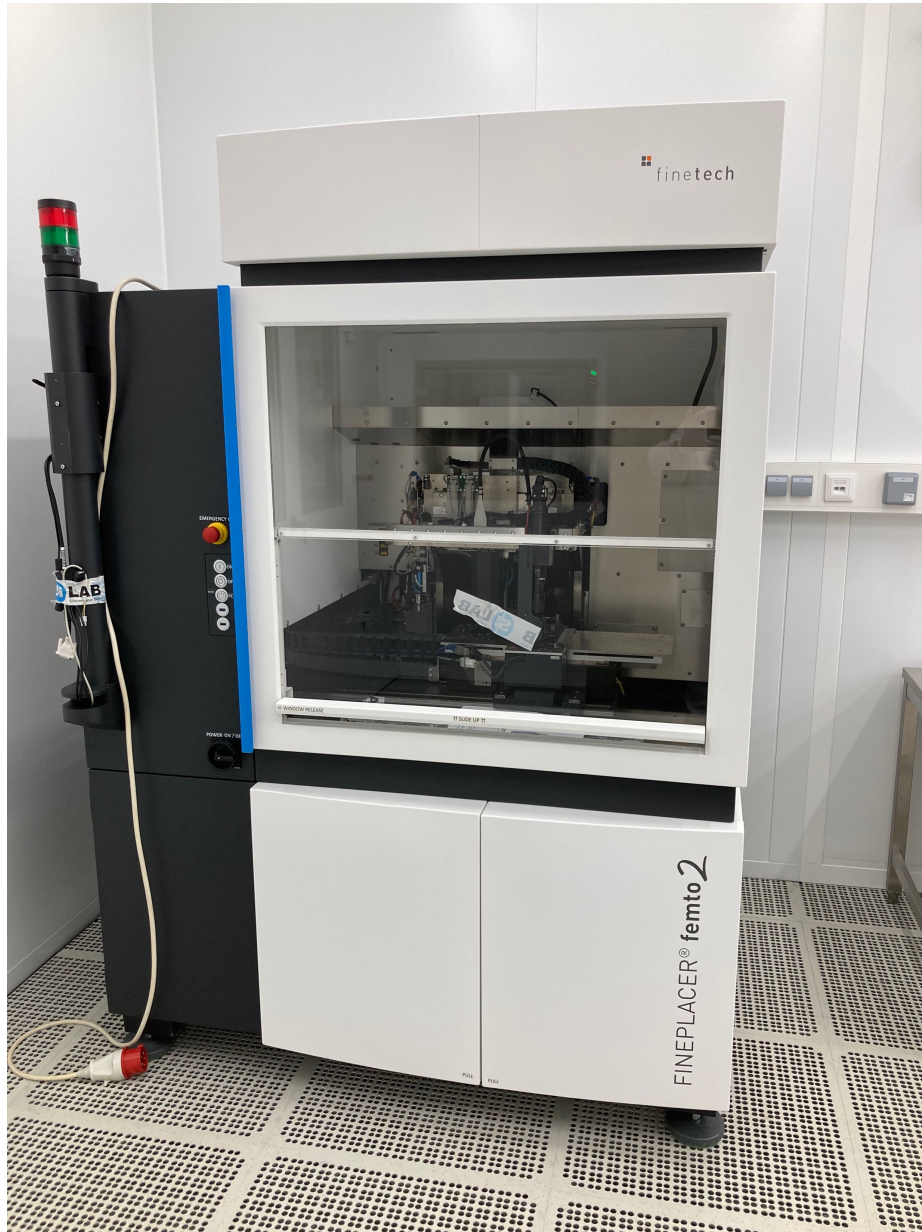
# ISO-6 room Interconnect Lab



# Wafer probing machine



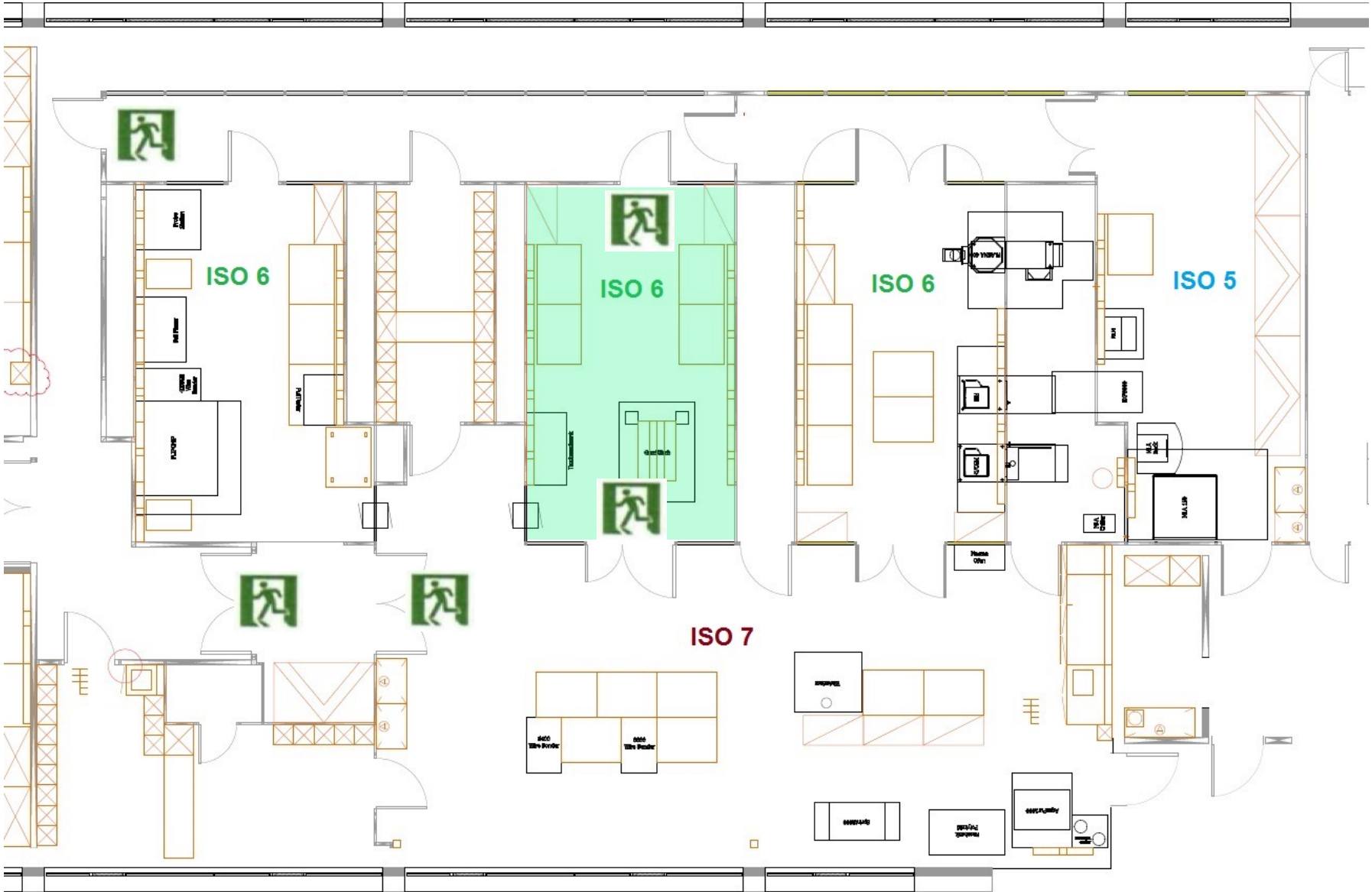
# FINEPLACER bonding system



# Solder Ball Attach Machine



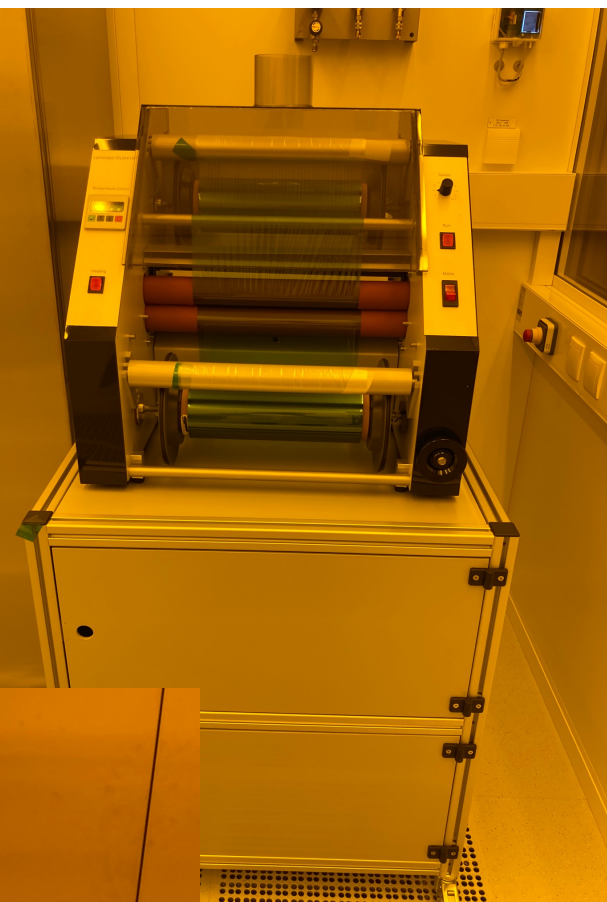
# ISO-6 room Gas Detector Lab



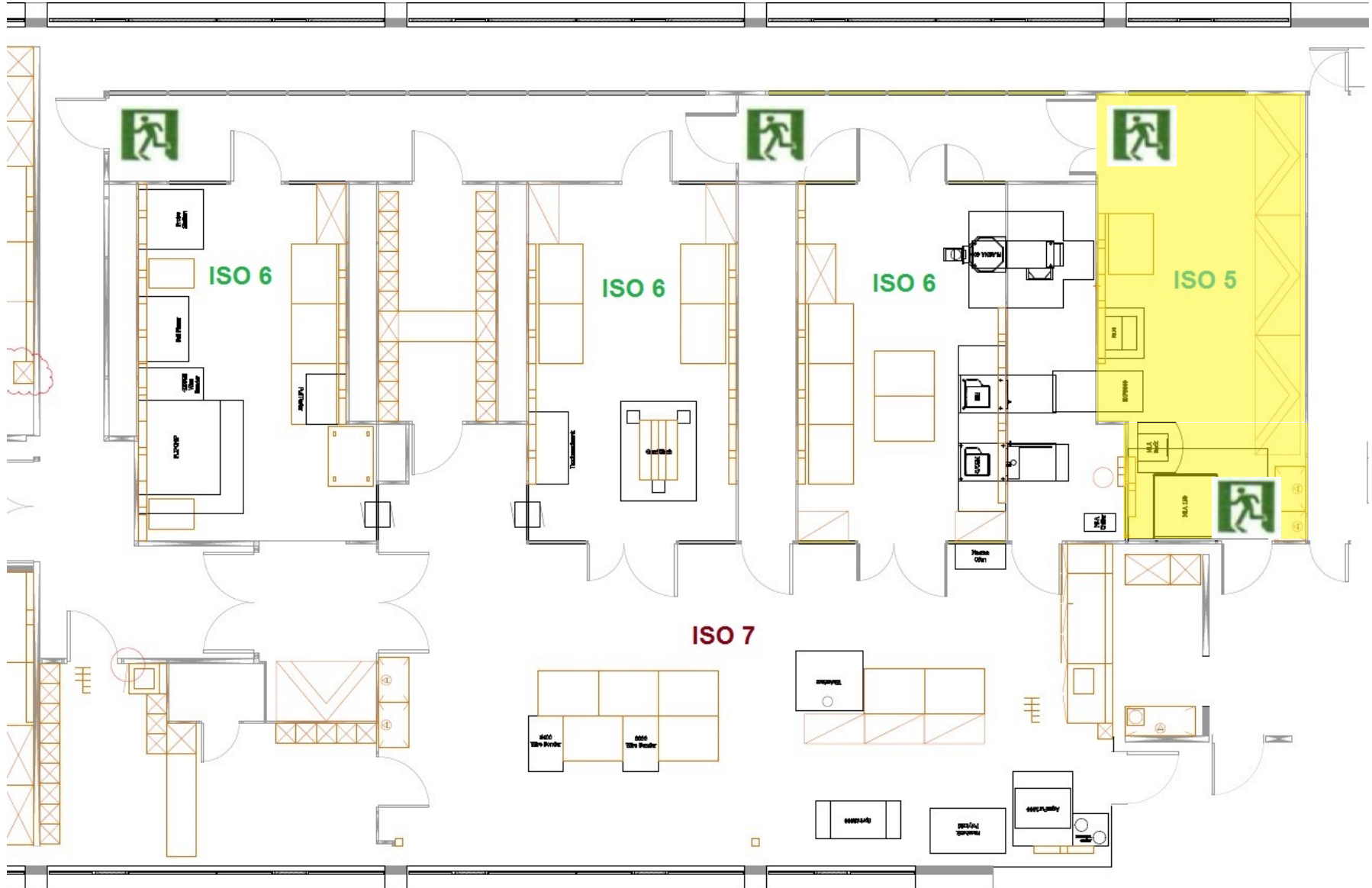






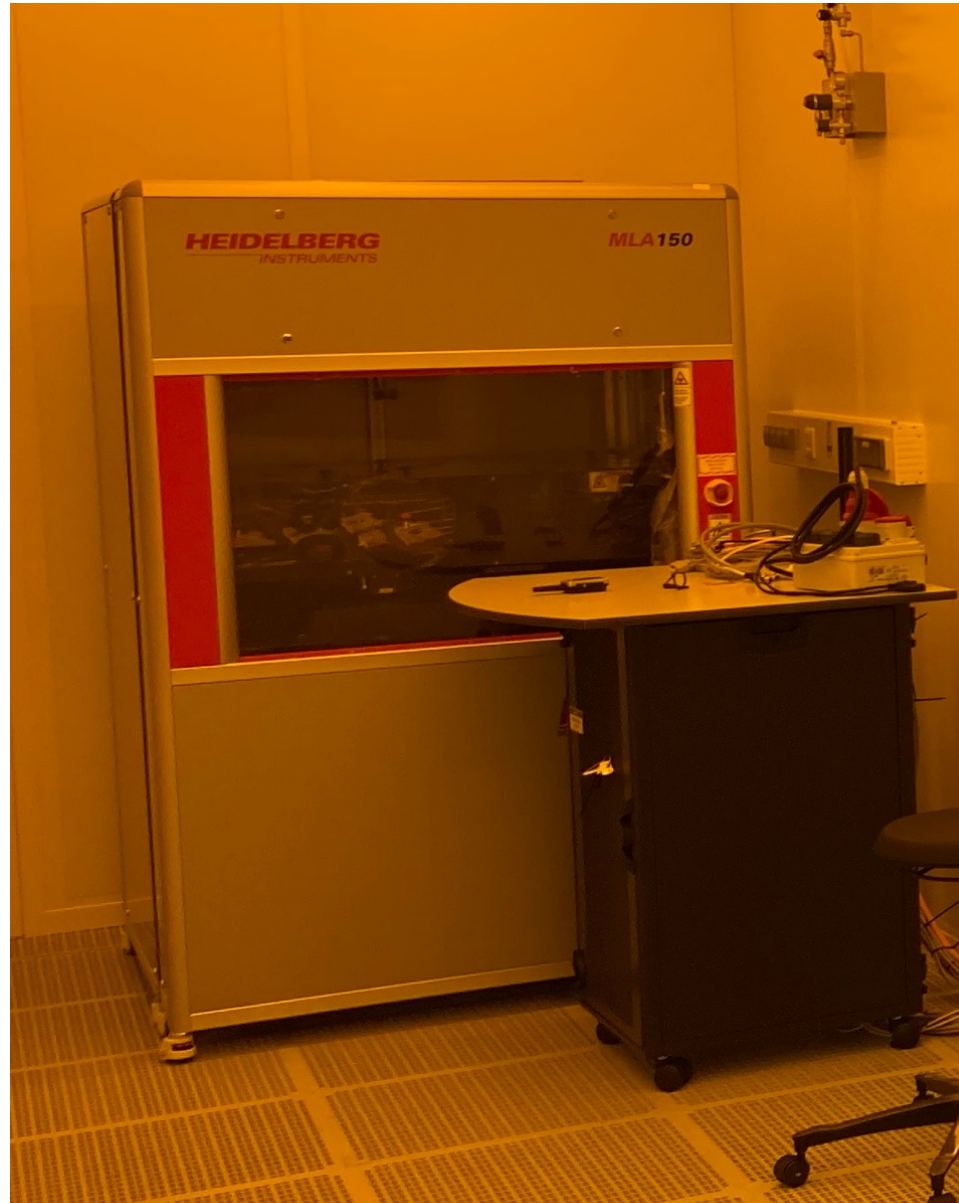


# ISO-5 room Photolithography and Wet Processing lab

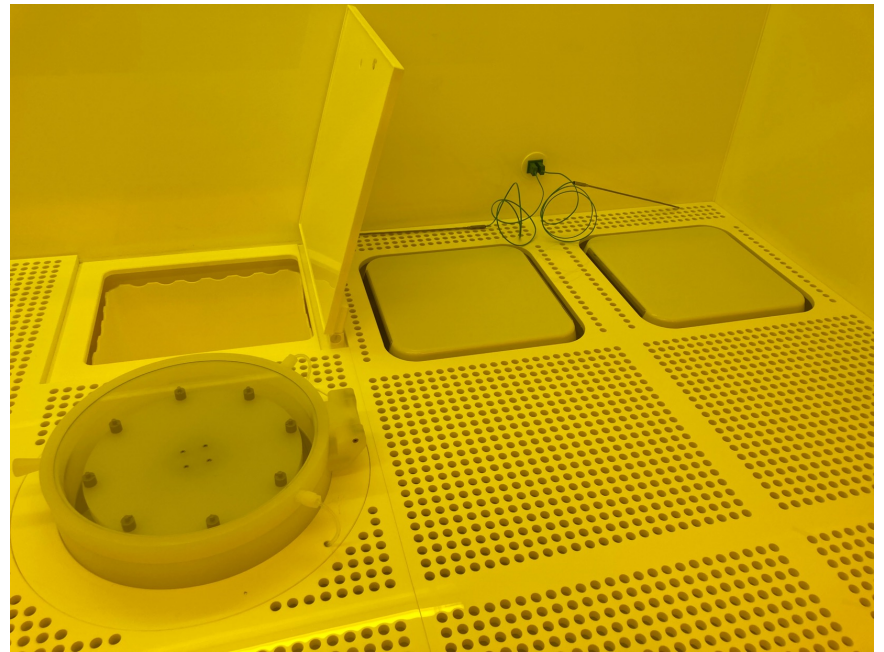
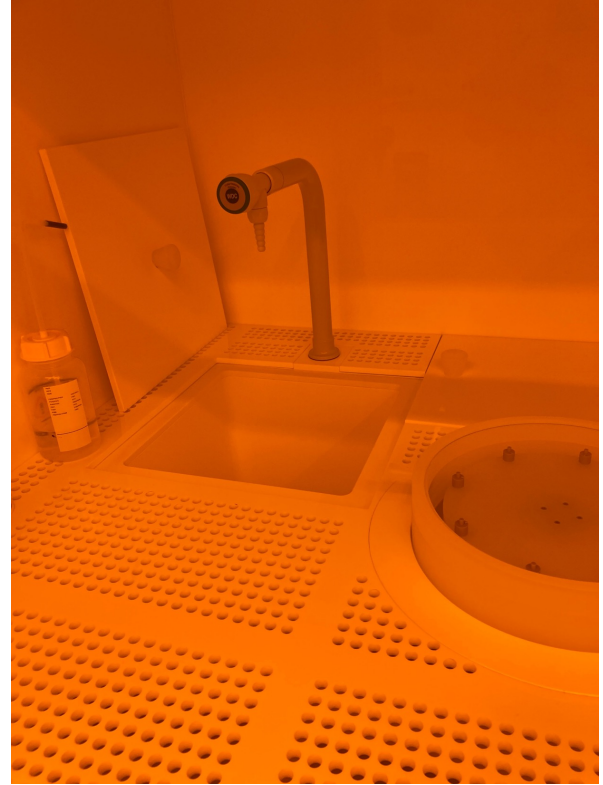
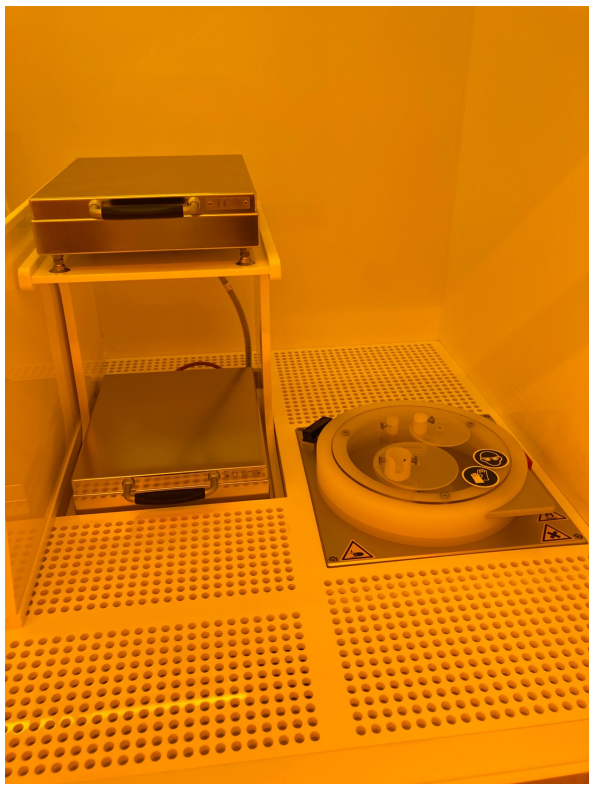


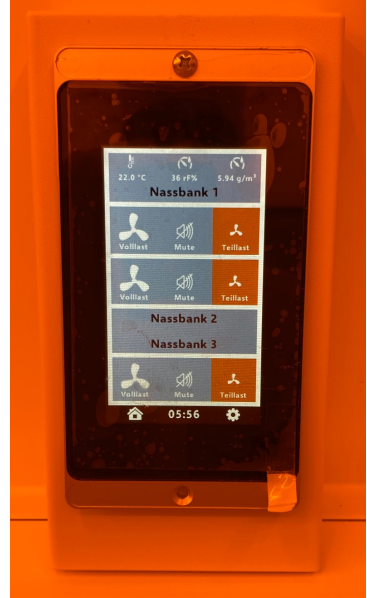
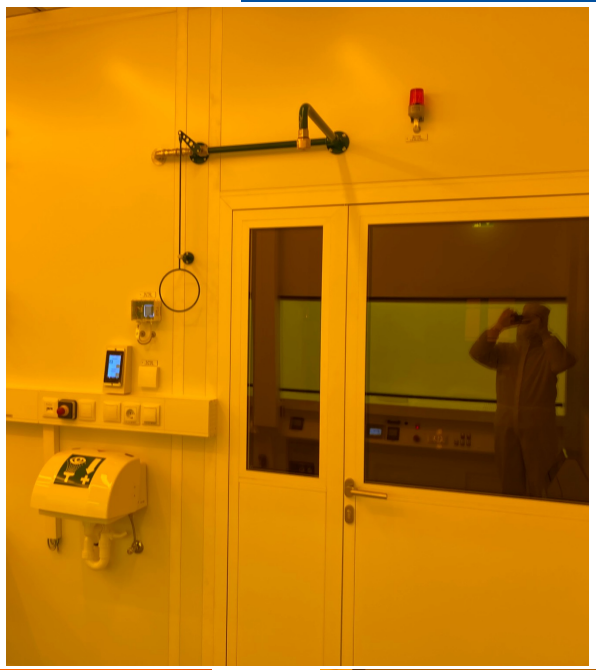
MLA 150

EXP3040LED









# FTD Cleanroom staff-members

**Head of cleanroom: Dr. Yevgen Bilevych**

**Email: [bilevych@uni.bonn.de](mailto:bilevych@uni.bonn.de)**

**Office: 2.050**

**Phone: 8250**

**Cleanroom technician: Jerome Laubner**

**Email: [jlaubner@uni-bonn.de](mailto:jlaubner@uni-bonn.de)**

**Office: 0.011**

**Phone: 3700**



# Chemical Lab



**Thank you for your attention!**





# How to get access to the FTD cleanroom?



## 1. Formal inquiry from group leader contains:

- Name of person who need the access
- Planned work with clarification of access area  
room 2.044 (ISO-7), room 2.060 – (ISO-6 GEM), room 2.064 (ISO-6 Interconnect),  
room 2.058 (ISO-6 yellow), room 2.056 (ISO-5 yellow)
- Duration of access
- Additional relevant information (purpose, project, processes, necessary tools, chemicals etc.)

Should be to send to: Yevgen Bilevych [bilevych@uni-bonn.de](mailto:bilevych@uni-bonn.de)

Markus Ball [mball@hiskp.uni-bonn.de](mailto:mball@hiskp.uni-bonn.de)

## 2. Introduction and trainings (Yevgen Bilevych [bilevych@uni-bonn.de](mailto:bilevych@uni-bonn.de)):

- FTD cleanroom introduction and safety course
- FTD cleanroom on-site individual training (educational cleanroom visit)
- FTD cleanroom exam (test visit of cleanroom)

## 3. Signing of FTD cleanroom User Policy Agreement

4. Re-programming of user transponder (Markus Ball [mball@hiskp.uni-bonn.de](mailto:mball@hiskp.uni-bonn.de)  
Yevgen Bilevych [bilevych@uni-bonn.de](mailto:bilevych@uni-bonn.de)).

## 5. Access to the FTD Cleanroom

# Cleanroom Users

**Initial Inquiry – 36**

**Introduction and safety course – 28**

**Cleanroom training – 24**

**Cleanroom exam – 17**

## **General laboratory rules :**

- **Full attention should be taken to own safety and that of your colleagues at all times.**
- **Only persons who have been instructed for the laboratory regulations may work in the laboratory**
- **Work on the devices may only be started after instruction and guidance from the laboratory manager or the person responsible for the device**
- **Work with hazardous substances/chemicals may only be started after prior knowledge of the operating instructions and safety data sheets.**
- **If hazards are to be expected, other suitable personal protective equipment must be used**
- **Hazardous substances brought in must be clearly marked and may only be stored in the designated areas. Labelling includes the name of the substance and the hazard symbols. For all samples, the bottling date/date of introduction and the name of the bottler/user must also be noted.**
- **Every work and commuting accident must be reported to the laboratory manager immediately**
- **Safety problems and deficiencies that occur must be reported to the laboratory manager and/or to the safety officer**
- **Defective devices must be clearly marked and the person responsible for the device must be informed immediately**
- **Escape doors and paths must not be obstructed.**
- **The workplace, tools/equipment must always be kept clean and tidy.**
- **Visitors only have access to the laboratory when accompanied by a responsible employee and with the agreement of the colleagues on site**
- **The work of external companies/persons (maintenance, repairs, cleaning, construction of new systems) requires special caution**

## **FTD cleanroom rules :**

- **Full attention should be taken to own safety and that of your colleagues at all times.**
- **Only persons who have been instructed for the FTD cleanroom regulations on record may work in the laboratory (annual instruction)**
- **Visitors must be escorted by a cleanroom staff member**
- **Proper clean room clothing (incl. mask and gloves) should have worn**
- **Alarms in the clean room must not be ignored. Appropriate action must be taken for the alarm situation immediately.**
- **Immediately clean and/or report any potential hazards (spills, leaks, fire hazard obstacles)**
- **The workplace, tools/equipment in the FTD cleanroom must always be kept clean and tidy.**
- **The cleanroom specific guidelines must be observed**

# **The clean room guidelines:**

- **Leave personal items outside the cleanroom environment.**
  - **Adhere to proper gowning and ungowning procedures.**
- Don't let anyone enter the cleanroom if they aren't appropriately covered, with clean and gloved hands, face masks, covered shoes, safety glasses, etc.**
- **Cover hair and facial hair.**
  - **Never open your gown in the cleanroom.**
  - **Never touch your skin or hair with your gloves. If you do, put on clean gloves immediately.**
  - **No food or drink is permitted in the cleanroom.**
  - **Do not wear makeup, perfume, etc. inside the cleanroom.**
  - **Do not run or move more quickly than necessary within the controlled environment.**
  - **Do not enter the cleanroom if you're unwell.**
  - **Do not sit or lean on equipment or work surfaces.**
  - **No corrugated cardboard, styrofoam, foam rubber or non-cleanroom paper is permitted in the cleanroom.**
  - **No pencil, erasers or retractable pens are permitted in the cleanroom.**
  - **Be considerate by cleaning up your own mess, not messing up someone else's work, letting the staff know when new supplies are needed, etc.**
  - **Ask for permission before bringing anything in or taking anything out of the cleanroom.**
  - **DO NOT modify equipment without the approval of the Cleanroom Staff.**
  - **Vacuum or blow clean all equipment followed by an Isopropyl alcohol wipe before taking it into the cleanroom.**
  - **Any work or tools dropped on the floor shall be considered contaminated, and must be cleaned**
  - **Label all chemicals or mixtures with Chemical Safety Warning stickers**

**IF YOU AREN'T SURE HOW IT WORKS, ASK BEFORE YOU USE IT!**



# Chemical Safety

- All chemicals must be handled in wet benches or in some exhausted enclosure.
- Chemicals are to be handled and mixed only by personnel who are authorized and are wearing the appropriate personal protective equipment.
- Open chemical containers cautiously. Point the top of the container away from your face and body. Pressure may have developed inside the containers during transport.
- When pouring chemicals, pour slowly in a controlled manner to avoid splashing.
- After pouring chemicals from bottles, wipe the neck of the bottle clean to prevent the chemical from dripping down the side of the bottle and damaging work surfaces or personnel.
- “Always Add Acid” (AAA) to water, never the reverse.
- Do not mix a solvent with an acid or mix an acid and a base. Solvents and oxidizers must never be stored or mixed. These chemical groups are incompatible and can react violently.
- Immediately clean up chemical residues on work surfaces.
- When bottles are completed they must be properly cleaned and disposed of.
- To reduce possibility of fire or explosion chemicals can only be heated to less than 10 degrees of flash point of that chemical

# ISO-6 Lab update

## Leybold UNIVEX 400



The UNIVEX 400 is Leybold most popular box-coating system for R&D and pilot-scale coating applications. UNIVEX are multipurpose coating systems for the production of functional physical deposition (PVD) layers.

### Common Applications:

- Thin film solar: CdTe, CIGS, CZTS sputtered processes
- Organic Electronics (PV, OLEDs)
- Optical coatings
- Microelectronics
- Sensor technology

### Typical Configurations:

- Multi-pocket e-beam with thermal evaporator and ion source.
- Up to four 2" sputter guns in confocal configuration for sputter up or down
- E-beam and organics evaporators for inorganic-organic perovskite formation

### Features

Chamber Size Width: 420 mm

Depth: 480 mm

Height: 550 mm

Thermal evaporation: Up to 8 materials

Organic evaporation: Up to 8 materials

E-beam Evaporation: Multi-pocket and/or single pocket

Sputtering: Up or down, 4 X 2", 3 X 3", 2 X 4" or other

Co-Deposition: Evaporation and/or sputtering

Ion Assisted Deposition: Optional

Loadlock compatible: Optional

Water tempered chamber: Optional

Vacuum Level: Mid  $10^{-7}$

UHV Version: Optional

Cleanroom compatible: Yes

