INSTITUT FÜR HALBLEITER- UND FESTKÖRPERPHYSIK

Johannes Kepler Universität Linz, Österreich

Laboratory Rules

(Version: 6 December 2013)

Rules of conduct and safety for all laboratories

For all areas of the institute, the responsibility for the functioning, cleanliness and security of all instruments or installations is delegated to the persons working there; they can be found in a list at the end of the laboratory rules.

By principle, institute members may operate instruments or installations (e.g. UHV or HV systems, the MOVPE system, X-ray diffractometers, Lasers, ESR or IR spectrometer, Hall-effect set-up, chemistry lab, cleanroom and mechanical workshop) only after introduction and instruction by the respective person in charge and after written confirmation on the corresponding institute form that he/she obtained and understood this instruction perfectly well.

The first-time start-up and operation of instruments by a coworker must occur under supervision of the person in charge or his/her delegate.

Any security relevant deficiencies of an instrument or an installation in the laboratories must be repaired immediately and access has to be stopped until complete repair has been achieved. Every user finding out such deficiencies must report those immediately to the person in charge.

Before using and introducing new chemicals to the lab, i. e. already at the stage of application for a new project, the head of the institute of semiconductor and solid state physics has to be informed about these plans. If the use of these new chemicals puts a risk on the valid security regulations, then the necessary measures have to be taken before their use in order to guarantee the security for all persons in the building.

Every user (Post-doc, PhD, diploma student, technician) is obliged to participate in and to contribute to the regular maintenance work and she/he is fully responsible for the function of instruments assigned to her/him. This responsibility includes that this person has to take care of the prescribed maintenance measures either by her/himself or she/he has to find somebody to do it.

The entrance doors of the building have to be kept closed outside the opening hours (Monday to Friday: 8:00–17:00), especially at the weekend.

Severe violations of the laboratory rules imply loss of permit to use specific instruments and facilities, which can lead to a termination of diploma or PhD work. From the point of view of legal responsibility or insurance regulations, careless behaviour may cause loss of coverage as well as recourse request and legal prosecution.

General Rules

- It is forbidden, without exception, to store and consume food and beverages in the laboratories.
- Smoking is absolutely forbidden in the laboratories – as in the entire Institute of Semiconductor and Solid State Physics.
- Every user is responsible for the maintenance of the equipment, instruments and devices he/she makes use of. This includes also the cleanliness of the working environment and the functioning check of the instruments/devices before and after use.
- Contaminants and deposits at the working environment, which could be source of danger must be promptly removed, i.e. everyone must leave the working environment clean and clear of any possible sources of accidents. Do not block escape routes!
- In case of malfunctioning, the responsible person for the instrument/assembly has to be immediately informed.
- The temporary use of equipment is only allowed upon consultation with the respective person in charge. This applies also for small devices that can not be considered as part of an experimental set-up or that are unidentified.
- In case that the responsible person is not accessible and equipment is required only for a short period (up to 4 hours), the device may be borrowed only if a written notification specifying the name of the borrower, her/his coordinates (telephone number and e-mail address) and the kind of temporary use of the equipment/device is provided.
- There is the absolute obligation to return the borrowed devices after reasonable time.
- All laboratories are equipped with tools. The tools must be returned to the designated place. Particular tools belonging to specific set-ups or dedicated to a specific purpose are not meant for general use.
- A number of workplaces (e.g., Hall stages, microscopes, diffusion-ovens, etc.) may be generally used. For all these instruments/set-ups there are logbooks, where the use of the corresponding stage/device/system must be recorded with the appropriate entry (date, name). Also in this case, the use requires necessarily an introduction by the responsible person in charge.
- Materials degrading or changing their properties with time should be periodically checked and substituted, if necessary. This concerns particularly water-pipes in cooling systems.
- Upon change of oil in pumps, and generally upon maintenance and repair, respective notes have to be placed at the instruments.
- Consumables necessary for the experiments (gaskets, screws, filaments, etc.) have to be re-ordered in time.
- The experimentalist takes the responsibility to put water sensors in the appropriate places on the laboratory floor.

Molecular-Beam-Epitaxy (MBE) Systems

- Upon venting the ultra-high vacuum (UHV) system, care has to be taken to avoid the build-up of overpressure in the UHV system, which may cause the cracking of view ports or other vacuum feedthroughs.
- When opening the III-V-semiconductor MBE-system, it has to be assured that there is no contamination of the laboratory room by evaporation material. Protective clothing (lab coat, respirator mask and safety gloves) must be worn during the re-filling of the evaporation material. Any repair work has to be conducted only in the flowbox. After finishing the work, the front shield of the flow box has to be closed and the flow box has to be switched off.
- When baking the ultra-high vacuum chambers, one must bear in mind that some parts (e. g. ion getter pump) get very hot (approx. 200°C) and can cause severe burning when touched.

Metal-Organic-Vapour-Phase-Epitaxy (MOVPE) Systems

- In case of fire in the laboratory or the equipment one must not use water for fire extinguishing. Instead, use the fire extinguisher in the laboratory. (Water accelerates the combustion of metal-organic compounds.)

- In case of an emergency alarm (red or blue emergency lights and acoustic emergency signal) one must follow the written instructions displayed in the. The instructions are also displayed on the laboratory door, the door to the room with the evaporation systems as well as in the staircase.
- Open handling of alcohol (e. g. ethanol) is strictly forbidden in the laboratory. It would cause immediate gas alarm.

Evaporation systems and ovens

- The use of bell jar cages is obligatory for evaporation systems containing glass bell jars (implosion protection!).
- If necessary, a protective face mask and gloves must be worn upon opening the evaporation system.
- Storage and/or heating of any explosive substances inside the heating chambers are strictly forbidden.
- Use protective eye glasses or face shield when melting off or cooling glass ampullae.

Laser

- Operating lasers as well as working in marked laser safety areas is allowed only after a proper instruction by the person in charge for laser safety. In particular, the safety of third parties has to be assured. When operating at high laser powers one has to be particularly aware of combustion hazard.

- The personal tutor is responsible for the availability of protective gear (laser protective goggles). The person in charge of the laser instrument is responsible for the proper set-up of the laser safety area.
- The operational reliability of the warning lights for laser operation has to be assured.
- Instructions displayed at the laboratory entrance area must be strictly followed. When laser operation is indicated by the warning lights, entrance to the laboratory is allowed only for well-instructed personnel wearing protective gear.
- Obey elementary rules for operating lasers, e. g. avoid unnecessary reflections or do not look directly into the laser beam.
- The laboratory has to be secured in a proper way in order to assure that persons not working in the lab are informed about the hazards. Any person who is working in the same laboratory must not be endangered by the laser operation.

X-ray Diffractometers

- Before using an x-ray diffractometer, a special training by the radiation protection officer and an instruction by the respective person in charge of the diffractometer are mandatory. All persons that are regularly working with x-ray diffractometers have to wear their personal radiation badge during their stay in the laboratory.
- Access to the x-ray laboratories is limited to authorized persons. A warning lamp at the entrance indicates if the x-ray diffractometers are operating.
- There is a logbook for each x-ray diffractometer, where date and operator have to be logged before its use.
- In case of any irregularity in operation of a diffractometer the radiation protection officer and the respective person in charge have to be notified as soon as possible. Furthermore, any irregularity in operation must be reported in the logbook.
- The diffractometers are equipped with radiation protection enclosures to prohibit enhanced radiation levels in the laboratory during normal operation. If work has to be conducted with opened/removed enclosures, e.g. for alignment purposes, it has to be ensured that only persons involved in the work are present in the laboratory and no other persons can enter the laboratory. In that case the work must be conducted efficiently, and protection equipment such as mobile lead glass screens must be used to minimize stray radiation. Care has to be taken not to reach into the direct or diffracted x-ray beams. If work has to be interrupted, the x-ray shutter has to be closed and secured against reopening.
- In the x-ray laboratories gas cylinders under high pressure (200 bar) containing detector gas (95% Argon, 5% Methane) are stored. The safety regulation for the use and storage of such gas cylinders has to be obeyed.
- *Measures in the case of power or cooling water failure:* In the event of a power failure, all diffractometers will switch off automatically. However, for extremely short power-loss only

the cooling circuit may be switched off while the diffractometer still being on. In that case the diffractometer has to be switched off manually or the cooling unit has to be restarted quickly, otherwise the diffractometer might overheat and gets damaged.

- If the main cooling circuit of the building is switched off, the cooling circuits of the x-ray diffractometers are NOT AUTOMATICALLY switched off! In the absence of cooling water for more than several minutes, the diffractometers need to be switched off manually to prevent overheating and a damage of the diffractometers,.

Microwave Sources

- In facilities containing microwave generators (ESR, ODMR, plasma asher, etc.) high power densities can occur that, if coupled into the surrounding, can be absorbed in organic tissues. For example, upon visual inspection of a microwave resonator, the human eye can be destroyed, if microwave pulses with peak powers in the kW range are absorbed.

Electric Installations

- According to Austrian regulations, all parts and leads under high voltage require technical means for protection against touching or exposure. Only personnel trained in the handling of high voltage components and circuits is entitled to perform installation and repair work. During whatever work on high voltage containing facilities and installations the high voltage source has to be switched off and disconnected from the circuit. Also, keep in mind that capacitors can store high voltages for a long time (minutes to hours), even if the high voltage source is disconnected. Therefore, after disconnecting the high voltage source, capacitors have to be discharged by shorting with an insulated discharge pole before any repair or installation work.
- Electric installations have to be regularly inspected for faulty insulation. If such defects are discovered, the facility or installation has to be shut down, disconnected and secured against accidental reconnection immediately. Report the incidence immediately to the person responsible for the facility or installation. The facility or installation with faulty insulation must not be operated until the defect has been repaired.
- Each flowbox requires a main switch for the activation of the incoming media (water, nitrogen), the sink and the outlet to the waste chemical disposal tanks, as well as the electric wall outlets inside and attached to the flowbox. After work in a flowbox has been completed, the sliding windows on the front side have to be closed (gently, to prevent the cables of the internal balancing system to jump off the guiding reels), and the main switch has to be brought in the off position.

High Magnetic Fields

- The conventional and superconducting magnets in several of our experimental setups create high magnetic stray fields, which can be a health hazard, especially for persons with a pacemaker.

- Loose objects of magnetic metals are attracted by strong magnetic stray fields and can be accelerated toward the source of the magnetic field. This can cause harm or damage through flying objects. Even heavy objects, such as metal chairs or gas bottles may be accelerated by magnetic forces.
- Mechanical watches can permanently be damaged by magnetic stray fields and magnetic storage devices including bank and credit cards may become unreadable.

Cryogenic Liquids

- New collaborators are introduced to the general rules of using and operating with liquefied gases and cryogenic liquids by the respective person in charge.
- During the manipulation of cryogenic liquids, precautionary measures regarding the protection of eyes, hands, etc. have always to be taken.
- It is strictly forbidden to use an elevator that is loaded with cryogenic liquids.

Chemicals

- All chemicals used in the chemistry labs have to be labeled with the name of a person who is responsible for it. At the acquisition of chemicals the corresponding safety data sheets have to be organized and to be placed into the designated folders. The chemicals have to be stored in the chemistry safety cabinets. Before the chemicals are opened the safety data sheets have to be read and understood. Solvents which are purchased from our common budged are the only ones for common use. For these solvents our staff chemical technician is responsible.
- Before starting the work with materials that are not familiar to the user, enquiries about there possible toxicity and other risks have to be made (books like Toxikologie, W. Wirth, C. H. Klogshuber; Handbuch der gefährlichen Güter, Springer Verlag, which are available in the chemistry laboratory located in the TNF tower might be helpful in this respect).
- All containers and wash flasks containing chemicals have to be fabricated from appropriate materials and each of them has to be labeled with its content.
- Substances of low toxicity (acetone, ethanol, isopropanol, hexane, etc.) have to be handled in a flue. For all substances with significant toxicity (chlorinated solvents and nanomaterials) special precautions have to be taken in the chemistry labs. These precautions are either (a) increasing the flow velocity into the flue or (b) making sure that no other persons are entering the laboratory and wearing of appropriate respiratory masks. Both are only allowed after consultation of the person who is in charge of the chemistry lab. Substances of high toxicity (like bromine) or radioactive substances must not be used in the rooms of the solid state physics group.
- Acids, bases and strong oxidizers under no circumstances are allowed to be taken out of the chemistry laboratories or the clean rooms.
- Always dilute acids by adding the acid into the water and not the other way around.

- Hydrofluoric acid must not be used in glass containers. During the work with HF an anti-hydroflouric acid solution has always to be hold in readiness.
- Elemental bromine reacts violently with almost all organic substances. Bromine containing solutions and etches like Br_2-methanol should not be used in plastic containers. In the solid state physics group the use of bromine is not allowed at all.
- The vapors of chlorinated carbon hydroxides like trichloroethylene cause damage to the liver and can cause cancer. Their use is only allowed inside the flues.
- Heavy metals like Hg, Cd and Pb are extremely toxic in the form of their salts. They also accumulate in the body and therefore their use is problematic even in small quantities. Therefore special care is necessary when using these materials. Arsenic is not toxic in its elemental form and not in the form of GaAs. Arsenic oxide, in contrast is toxic and arsenic hydrogen (AsH_3) is highly toxic.
- According to the Austrian regulations for health control at the working environment (VGÜ) employees routinely working with heavy metals and other toxics [listed in VGÜ §2.(1)] have to untertake a health test before starting the work as well as periodic health tests upon continuing the work. Furthermore, the occupational health practitioner of the Johannes Kepler University has to be informed.
- Upon grinding and polishing of samples fine powders may be generated that are dangerous if inhaled. Wearing respirators is recommended.
- On the chemistry tables in the clean room and in the chemistry labs flush bottles for the eyes are placed. In case of chemical burns in the region of the eyes these bottles have to be used immediately.
- In the chemistry labs there are separately ventilated lockers for a) burnable solvents and b) toxic chemicals. In the cupboards mounted below the chemistry work places you find compartments for c) acids and d) heavily oxidizing materials. All chemicals have to be stored in the predefined places. Materials contained in tightly closed boxes can also be stored in the refrigerator.
- Unused remainder of chemicals, independent of being acids, bases or solvents are not allowed to be returned into the original containers (in order to avoid cross contamination!).
- Pipettes are not allowed to be dipped into the original bottles, instead use separate beakers. It is strictly forbidden to suck any liquids into the pipettes by mouth alone.
- Broken and damaged glass beakers have to be disposed.
- Chemicals, etching solvents or other mixtures are not allowed to be stored in the exhaust hoods. In case that certain solutions, e. g. special etchants, are used several times, they have to be stored in appropriate containers that can be tightly closed and contain labels of date, composition of the solution and the name of the user. Insufficiently labelled containers will be disposed without further warning by the person in charge for the chemistry labs.

- For any activities in the chemistry labs the appropriate security equipment has to be used, such as suitable gloves and aprons that are resistant against acids or solvents, closed shoes, and if necessary safety goggles and respirators. The supervisor of each person working in the chemistry lab is responsible for providing the necessary safety equipment.
- Acid resistant aprons, gloves and safety goggles have to be used in any case, when an etching solution is prepared from acids and bases, or when such solutions are heated. Bottles containing acids or bases should never be touched by bare hands, because remaining chemicals at the bottles may give rise to cauterization.
- Eye washs have to be tested on a regular basis (1× per week) for their functionality. The respective wash bottles have to be filled with clean water when starting the work and emptied again after finishing.
- Even methanol and acetone are poisonous and inflammable in higher concentrations. The central location of the chemistry lab with respect to all other labs allows to perform any activity with organic solvents under an exhaust hoods of the chemistry lab.
- After any activity in the chemistry lab the hands have to be carefully cleaned.

Disposal of Chemicals

- The following groups of chemicals are disposed separately from each other: a) non-chlorinated solvents (acetone, methanol, ethanol, isopropanol, toluene, hexane, oleic acid); b) chlorinated solvents (chlorobenzene, chloroform, trichloretylene, tetrachlormethane, tetra-chlorethylene); c) anorganic acids (sulphuric acid, hydrochloric acid, nitric acid, phosphoric acid), d) organic acids (citric acid, acetic acid, glacial acetic acid); e) bases (sodium hydroxide, potassium hydroxide, ammonia, calcium hydroxide, lithium hydroxide); and f) hydrofluoric acid. All other solutions (like for example Piranha, hydrogen bromide, or solutions containing oxidizing agents, remover (Microposit), etc.) have to be disposed separately from each other and must not be mixed. The respective waste containers have to be labelled with respect to their content and by the name of the responsible person(s). Disposal of these containers is organized by the responsible person(s). Any other waste has to be put into the boxes stored in the extractor hoods. For each waste box there is a list, where the approximate amount and kind of waste as well as the name of the person that disposed the waste have to be noted.
- In case of accidentally putting a chemical/solution into a wrong container the responsible person has to be informed immediately.
- Emptied containers which contained harmful substances, in particular flammable liquids, have to be cleaned thoroughly before they are disposed or used for other purposes.
- The disposal containers in the rooms G2, G4 and G5 have to be checked on a regular basis regarding their tightness, functionality and filling level. Full containers have to be brought to the central disposal place of the university.

Handling of gases in high-pressure containers

- *Transport of individual gas containers over small distances*: Before lifting a gas container at its safety cap, it has to be checked that the cap is tightly mounted. Large containers have to be rolled up right over the container base by putting one hand on the cap of the container for steering it and the other hand on the container surface in order to move the container. In addition, there are dedicated transport trolleys for these containers. When using these trolleys, the containers have to be secured against uncontrolled movements by the available chains. Small gas containers without safety caps have to be carried in such a way, that they can not fall down and their valve can not be opened accidentally. Using a suitable container box or bucket is recommended for transport.
- *Storage of gas containers*: For storage and use of gas containers, vented safety cabinets are available. In these cabinets, the gas containers have to be secured against tipping. Moreover, flammable and flame enhancing gases have to be stored in separate cabinets. Gas containers may be used only for short times outside these cabinets, but are not permitted to be stored outside.
- *Installation /Deinstallation*: Gas containers have to be secured against tipping at the place where they are used. The security caps and, in case, the valve-closing nuts have to be removed. The security cap should be removed by hand only without using tools, care has to be taken that the cap is screwed correctly onto the thread otherwise the gas valve might open during unscrewing the cap. Instead of the security cap, a security basket might be in place. This basket is permanent safety equipment and must not be removed. It is not allowed to open the gas valve for checking if the container is still under pressure. The specifications of the equipment for taking gas out of the container (pressure reducer, adapter, high-pressure pipe) have to match the maximum pressure allowed for the used gas container (for example: 300 bar). Always open the valve of the gas container by hand, do not use a tool to open it. Check, whether the connection between gas container and pressure reducer is tight (for example: close the valve of the container and watch the manometer on the high-pressure side of the reducer while the valve on the low-pressure side of the reducer is still closed; if the connection is tight, the reading of the manometer does not change). Adjust the pressure reducer to the pressure that is needed for the application, and then open the valve on the low-pressure side of the reducer. During working breaks and after finishing the work, the valve on the gas container has to be closed in order to prevent any uncontrolled gas flow. Containers should not be emptied down to zero overpressure. Small overpressure should remain in the container to prevent gases from outside getting into the container. In order to replace a gas container, close the bottle valve, demount the pressure reducer, put the safety nut and safety cap in place, so that the container can be picked up by the gas company.
- For *Oxygen* only blue marked manometers labelled “Öl und fettfrei halten (keep free of oil and grease” have to be used.
- Detailed instructions for a safe handling of gases can be found under http://lindegas.de/international/web/lg/de/likelgde30.nsf/docbyalias/safety_info. Bundles of gas containers are only used outside the building and are delivered and maintained by specially instructed persons.

How to react in case of emergency

General rules:

- Operator security overrides equipment security
- Keep calm and avoid blindfold actions
- Warn endangered persons and provide assistance in leaving hazardous rooms or ask for leaving these rooms
- Provide first aid
- Request help (Fire brigade 122, Police 133, Ambulance 144, Euroruf 112, Center for handling poisonings 406, Fire-Prevention TUG 4122)
- Without exception, any accident has to be reported to the institute's person in charge for security, and the head of the institute.

Who has to be informed: Porter's lodge at the University:...Tel. 8231

- **Fire brigade: .....Tel 8122**
- **Police: .....Tel 8133**
- **Ambulance: .....Tel 8144**
- **Center for handling poisonings:..Tel 01/4064343**

A) In case of fire:

- **Alarm**
  – Activate immediately the fire alarm
  – Call the fire brigade (Tel 8122)
  – Be prepared to answer the following questions:
  Where is the fire? What is burning? Are there any injured people?
  If so, immediate rescue action necessary!
  – Leave the burning building using emergency exits
  – Warn people who might be endangered
  – Do not use elevators
  – Close fire-doors and all room doors
- **Extinguish**
  – Start extinguishing the fire with the available installations
  – Wait for fire brigade and brief firemen
  – Inform firemen about particular dangers

B) In case of accidents:

In case of accidents engage in first aid but consider self-protection and inform the ambulance

Poisoning, Toxication

In the following rooms toxins are being stored:

- Cleanroom 1 (organic solvents, acids, bases (lyes))
- Cleanroom 2 (organic solvents, acids, bases (lyes))
- Cleanroom 3 (materials for evaporation, acids, lyes)
- Cleanroom 4 (solvents, acids)
- Chemistry laboratory at 1st floor (major stock for hazardous materials)

In case of toxication (even if just suspected) a physician has to be consulted

Toxic Vapors

- Injured person has to be brought outside of the building
- In case of apnoea: start immediately artificial respiration (mouth to mouth breathing)

- Call a physician
- In case of unconsciousness (absence): bring injured person into a recovery position

Acid and alkali burns

- Removed soaked clothes immediately
- Affected parts of the skin should be washed with running water
- Burned part of the skin should be protected with sterile cloth
- If eyes are injured: wash wide opened eyes several minutes in running water or use available eye bath bottles for this purpose.
- See immediately an eye specialist at the Allgemeine Krankenhaus in Linz

Emission of nitrogen

- Watch the O_2-level indicated in the ground floor. For values lower than 15% do not enter the basement because of risk of suffocation and call the fire fighters.

Alarm signals and alarm plans

Alarms: MOVPE

Alarm 1: outside of the laboratory!

BLUE rotating lamp outside the lab's door + SIREN

If H_2 (hydrogen) or NH_3 (Ammoniac) are detected in the MOVPE laboratory or in the adjacent room, the alarm is activated (blue rotating lamp over the lab's door + siren). When the gas concentration in the air surpasses the certain level (which is far below the security limit) and the above mentioned alarm is activated, magnetic valves automatically close and interrupt the supply of H_2 and NH_3 to the MOVPE system. Only the residual gas in the lines can leak into the rooms. Nevertheless, for security reasons, it is advised to leave the building and call the fire-brigade to check the gas concentration

POTENTIAL DANGER (FIRE, EXPLOSIONS)

Actions:
- open windows
- evacuate the building
- call the fire-brigade

Alarm 2: RED blinking LEDs and lamps + BEEPER (on the MOVPE system and Scrubber

These alarms are activated every time there are fluctuations in the ventilation system, pressure instabilities inside the MOVPE setup, minor faults in the functioning. The MOVPE reactor is, in these cases, automatically set to a safe state in N_2 flow. There is no danger, but it is advised to alert the persons in charge of the MOVPE, so they can reset the system and avoid waist of resources (N_2).

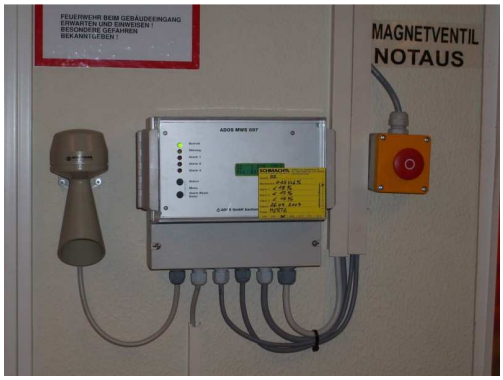
NO DANGER

Actions:
- close the door to the MOVPE lab
- do not touch anything in the lab
- alert the persons in charge

Liquid Nitrogen Filling Station – Emergency Plan

Display besides the stair case on the ground floor showing the oxygen content in front of the liquid-nitrogen filling station in the basement.

- In the case of alarm (loud signal-horn down-stairs), all persons have to leave the lower floor and to read the oxygen display beside the stair case on the ground floor.
- If the oxygen-display shows 20%, the alarm was initiated by a second sensor in the cleanroom and all persons immediately have to leave the clean-rooms. In that case a second sensor in cleanroom 4 anyway will initiate there a shrill signal-horn.
- If the display on the ground floor shows less than 20%, the alarm was initiated by the sensor in front of the liquid-nitrogen filling station.
- For a value between 16 and 19% the ground floor can still be entered in order to 1) press the emergency shut-off for the liquid-nitrogen line placed beside the control panel, 2) to open the emergency exit door in order to get fresh-air ventilation, and 3) to request remaining people to leave the basement or to help them in case of troubles.
- **AT OR BELOW AN OXIGEN CONTENT OF 15% THERE IS ACUTE DANGER OF LIFE.**



O_2-Control panel in the basement opposite to the filling station with alarm horn (left) and red emergency shut-off button (at right) for liquid nitrogen line.

At an oxygen level of 15% or less, it is prohibited to enter the basement without an oxygen respiration mask. **Attention – the respiration masks placed at the walls in basement and ground floor do not help against oxygen** deficiency **(only against toxic gases)!** The emergency door in the basement has to be unlooked and opened from outside in order to get fresh-air ventilation. Persons in the basement have to be alarmed by phone and requested to leave the rooms. If there is no alarm-horn active inside cleanroom 4, the persons can stay there as this room has a very efficient, independent ventilation system. The cleanrooms must not be left in any case via the main entrance as just there is the oxygen deficiency. If necessary, the cleanrooms can be left via the backside emergency exit doors and further via another emergency door to open air.

- **After their arrival, the fire brigade has to be admitted and instructed!**
- Hint: In the case of a false alarm (short-time Nitrogen emission) the alarm status can be stopped by pressing the lower button on the left hand side inside the control panel. The cover can be opened by pressing the grey, ripped part of the cover on the right hand side.

Alarm: Cleanroom

In case of emergency the cleanroom can be left through the escape doors in rooms 1 and 2 into the corridor behind. From rooms 3 and 4 one has to pass the entrance area in order to get to the escape doors. If this area cannot be entered (e.g. because of fire), a window in rooms 4 has to be smashed for escape. For that purpose, a big fire ax is fixed at the wall beside the windows. In the case of gas alarm, activated by the oxygen sensor in room 4 or by a toxin gas sensor in the maintenance area behind (greyroom), the cleanroom has to be left immediately through the main entrance door. In any case the competent persons have to be informed. Only after finishing of alarms and or dangerous situations the cleanroom can be entered again.

Emergency list of persons in charge / Semiconductor Physics

Room	Name	Telefon
R007 Elektronic work shop	Ernst Vorhauer Thomas Fromherz	0688-815 53 33 07234-873 96
R008 Mechanical work shop	Friedrich Binder Josef Jägermüller Gunther Springholz	0699-811 63 897 0664-515 87 88 0732-246 775 + 0699-884 95 853
R011 MBE-Room	Gunther Springholz	0732-246 775 + 0699-884 95 853
R012 Luminescence-Lab - Photoluminescence - Fourier spectroscopy	Thomas Fromherz	07234-873 96
R905 Big Lab - Magnets - Fourier, IR-Laser, Hall-Effect - OPO-Laser	 Gerhard Brunthaler Thomas Fromherz Georgios Katsaros Wolfgang Heiss	 0732-243 810 0676 464 3398 07234-873 96 0732-610 166 + 0680 445 7709
R906, R907 X-Ray-Labs (Rotating anode, PC-Server, HRD, MRD, XRD)	Julian Stangl Stephan Bräuer	0732-758 693 + 0699 1503 2987 0699-81 22 77 05 + 07234-82552
R908 AFM-Lab, SQUID - AFM - SQUID	 Gunther Springholz Gunther Springholz	 0732-246 775 + 0699-884 95 853 0732-246 775 + 0699-884 95 853
R909 Hall-Lab (Ofen r.)	Thomas Fromherz	07234-873 96
R910 Crude Chemistry Lab	Alma Halilovic	0660-211 97 69
R911 Entire Cleanroom	Gerhard Brunthaler Stephan Bräuer Friedrich Schäffler	0732-243810 0699-81 22 77 05 + 07234-82552 0676-69 33 115

Room	Name	Telefon
R1: - E-Beam Lithography	Friedrich Schäffler	0676-693 31 15
- Mask Aligner	Thomas Fromherz	07234-873 96
-Wafer Bonder	Kurt Hingerl	0660-696 845 + 07253-7640
R2: - Deposition Chamber	Wolfgang Heiss	0732-610 166
- Mask Aligner	Alma Halilovic	0660-211 97 69
- Rapid Oxidizer	Friedrich Schäffler	0676-693 31 15
- Wafer Probe, Par. Anal.	Friedrich Schäffler	0676-693 31 15
- Ambios XP1 (Surf. Prof.)	Stephan Bräuer Thomas Fromherz	0699-81 22 77 05 + 07234-82552 07234-873 96
- Spinner	Alma Halilovic Stephan Bräuer	0660-2119769 0699-81 22 77 05 + 07234-82552
- Microscopes	Friedrich Schäffler	0676-693 31 15
R3: - Deposition Chamber	Stephan Bräuer Thomas Fromherz	0699-81 22 77 05 + 07234-82552 07234-873 96
- Oxford RIE 80	Friedrich Schäffler	0676-693 31 15
- Oxford ICP 100	Stephan Bräuer	0699-81 22 77 05 + 07234-82552
- Oxford Abscheider	Stephan Bräuer	0699-81 22 77 05 + 07234-82552
- Annealer	Stephan Bräuer Ernst Vorhauer	0699-81 22 77 05 + 07234-825 52 0688-815 53 33
R4: - Asher	Stephan Bräuer	0699-81 22 77 05 + 07234-82552
- Si-MBE	Friedrich Schäffler	0676-693 31 15
- IV-VI MBE	Gunther Springholz	0732-246 775 + 0699-884 95 853

Emergency list of persons in charge / Solid State Physics

Room	Name	Telefon

R010 ESR-Lab	Andreas Ney	0699 1089 2097
R105 Big Lab	Clemens Simbrunner	
R105 MOCVD	Alberta Bonanni	0688 828 4140
R106 Deposition Labs	Sonja Roters	0650 4106 404
AFM	Stefan Müllegger	0650 - 8230353
R108 Chemistry 1+2	Wolfgang Heiss Sonja Roters	0650 6111167 0650 4106 404
R204 MBE-Magnetometers	Reinhold Koch	0732-917 517 0664 263 3478
R 205 LT-STM	Stefan Müllegger Reinhold Koch	0650-8230353 0732-917517
R 206 SQUID	Andreas Ney	0699 1089 2097
Hall	Alberta Bonanni	0688 828 4140
R209	Alberta Bonanni	0688 828 4140
R208 Photoluminescence		
ELMI	Wolfgang Heiss Alberta Bonanni	0650 6111167 0688 828 4140
R212 Optics Lab	Wolfgang Heiss Alberta Bonanni	0650 6111167 0688 828 4140

Useful Informations

If you work with acids or bases, or other chemicals, use the extractor hood and check if the air flow is sucked in! Never tighten the caps of acid bottles, otherwise within the bottle overpressure is built up and the next user is at risk! Furthermore, use safety-gloves and safety-goggles and a chemistry coat (if out of cleanroom) anytime!

Acids

Acids are liquids, which give rise to itching, redness and open wounds when coming into contact with your skin. For eyes even attenuated acids are dangerous. Acids are corrosive, especially on metals as iron, zinc, aluminium and the chemical reaction produces hydrogen gas (explosive).

In our labs different kinds of acids are used: hydrochorlic acid (HCl), nitrous acid (HNO_3), sulphuric acid (H_2SO_4 and vitriolic acid; phosphorous acids (H_xPO_y) and organic acids; furthermore hydrofluoric acid (HF), aqua regia (mixture between nitrous acids hydrochorlic acid), bromine compounds (e. g. HBr). Precautions for these compounds are given in more detail below. Most of the acids build, when opening the bottles, pungently malodours gases, which are heavier than air. Discomfort often appears hours later after use; if you feel disturbed after working with acids and bases, contact the medical doctor immediately!

If you have to dilute acids by yourself, pour the acid into the water under continuous stirring, never the other way round!

For sulfurous acids an exotherm chemical reaction will set in when brought into contact with paper and wood. Therefore take care of fire. Nitrous acids strongly react with copper, brass and bronze, and other metals.

When working with HF use plastic gloves. If HF comes into contact with your skin, use immediately Hexafluorine as first aid measure (stored in the cleanroom RR2 and RR1). Independent of this first aid action, contact a medical doctor immediately (risks for your cardiovascular system!). During the work with HF an anti-hydroflouric acid solution has always to be hold in readiness.

Do not pour or store hydroflouric acid (HF) in glass bottles. For waste HF use the especially marked waste HF bottles.

Bromine (Br), bromine- methanol, HBr and other Br- compounds: Take special safety-precautions; in particular, work under exhaust and use gloves and goggles. Do not store Br-compounds in plastic bottles.

Bases

Bases are also acidly and corrosive and also give rise to itching, redness and open wounds. The chemical reaction is stronger at higher temperatures and concentration; bases are especially attacking polymers, wool and leather — so take care of your clothes and use a chemistry coat!

For diluting bases in water, pour the base ***slowly*** into water to avoid splashing (always wear safety-goggles!).

Never mix acids and bases; the reaction is exotherm and very strong!

Hazardous Substances and Chemicals - Safe Use and Handling

Follow this link for the latest labeling and classification:

https://www.vci.de/Downloads/125164-Gefahrensybolik_Alt_EU-Neu_GHS.pdf

Substances are considered hazardous when their use or exposure causes a potential risk for life and health of humans, animals or plants or when represent particular risks for accidents such as fire or explosions. The national list of hazardous substances that is identical with that of the European Union contains about 3000 hazardous substances, and new substances are continuously added to this list. For about 1000 of them, critical threshold values of concentrations allowed at workplaces (so called MAK values) are defined. 40 substances are known to be carcinogen, for example asbestos, and in fact, at least 37 out of the 55 known occupational diseases are caused by the presence of hazardous substances at working places. As a result, **special safety measures** are required when hazardous substances are present or required at workplaces. The legal basis for handling of hazardous substances is the official regulation for hazardous substances.

Hazardous substances exhibit at least one of the following properties:

Very poisonous — poisonous — less poisonous — acidly — irritating — environmentally risky — explosive — highly inflammable — inflameable — fire boosting — carcinogen — teratogenic — mutagenic — otherwise harmful for humans.

The harmful properties of substances are indicated by the following **symbols** and are described as follows. If a substance in use is characterized by one of these symbols, the user should take particular care in handling of this substance and should get informed and comply to the particular safety measures established for their use in the lab.

T+

Very Poisonous

T

Poisonous

Xi

Irritating

E

Explosive

Very poisonous or poisonous: Substances or mixtures that can cause serious health damages or even death when inhaled, swallowed or incorporated by skin.

Harmful: Substances or mixtures that can cause health damages when inhaled, swallowed or incorporated by skin.

Acidly: Substances or mixtures that can cause tissue damage when brought into contact with the skin.

Irritating: Substances or mixtures that can inflame skin or mucous membranes immediately or upon repeated or continuous contact.

Environmental hazard: Substances or mixtures that can alter the properties of the environment like water, air, soil, climate, animals, plants or microorganism such that thereby immediately or later risk for the environmental conditions can result.

Xn

Harmful

C

Acidly

N

Environmental hazard

Explosive Substances and Mixtures can be brought to explosion under certain conditions, which are specified in the law for explosives. Depending on the achievable impact and the purpose of use the law for explosives treats different subgroups.

Fire-supporting Substances and Mixtures can ignite other flammable substance if brought into contact. In addition, active fire may be substantially enhanced and its deleting hindered.

O

Fire supporting

F+

Highly flammable

Highly flammable Substances and Mixtures are liquids with a flashpoint below 0°C and a boiling point of below 35°C.

Easily flammable Substances and Mixtures are:

- self igniting substances, e. g. yellow phosphorus
- solid materials such as celluloid, which can easily be inflamed by the short time action of an ignition source (e.g. match).
- Liquids with a flashpoint below 21°C, e.g. gasoline and acetone.
- flameable gases such as hydrogen and propane
- all substances that develop a flammable gas if brought into contact with water, e. g. sodium and carbide.

F

Easily flammable

Flammable substances and mixtures have a flashpoint between 21 and 55°C.

Carcinogenic substances and mixtures may cause cancer for human beings or increase the frequency of cancer development upon inhalation, swallowing or resorption by skin.

Embryo-affecting substances and mixtures may cause damage to the unborn child upon inhalation, swallow or resorption by skin.

Mutagen substances and mixtures may cause damage to the human genoms upon inhalation, swallow or resorption by skin, e. g. acrylamide.

In any other way dangerous substances and mixtures for the human beings may cause derogation of human health in any other way upon inhalation, swallow or resorption by skin.

Persons in charge for equipment / Semiconductor Physics

F. Binder

R008: Mechanical work shop

S. Bräuer

R906: x-ray laboratory: Drehanode
R907: x-ray laboratory: HRD, MRD, XRD
R909: Oven room: Ovens
R910: Crude chemistry
R911: Entire cleanroom
R2: Cleanroom 2: Ambios XP1 (Surface Profiler), Spinner
R3: Cleanroom 3: Deposition system, Oxford: RIE 80, ICP 100, Deposition system, Annealer
R4: Cleanroom 4: Asher

G. Brunthaler

R905: Big Laboratory: Low temperature systems/magnets
R911: Entire Cleanroom

T. Fromherz

R007: Electronics work shop
R012: Lumineszence-laboratory: Photolumineszence, Fourier spektrometer
R905: Big Laboratory: IR-Laser, Fourier spektroscopy, Hall Measurements
R909: Oven room: Hall Measurements
R1: Cleanroom 1: Holographic Lithography (Laser), Mask Aligner
R2: Cleanroom 2: Ambios XP1 (Surface Profiler)
R3: Cleanroom 3: Deposition chamber

A. Halilovic

R908: AFM-Laboratory: AFM
R910: Crude Chemistry
R1: Cleanroom 1: Holographic Lithography (Laser)
R2: Cleanroom 2: Mask Aligner, Tec-Tac, Spinner

U. Kainz

R910: Crude Chemistry

F. Schäffler

R1: Cleanroom 1: e-beam lithography
R2: Cleanroom 2: Rapid Oxidizer, Wafer Prober/Parameter Analyzer, Mikroscope
R3: Cleanroom 3: Oxford: RIE 80, ICP 100, Abscheider
R4: Cleanroom 4: Si-MBE

G. Springholz

R008: Workshop
R011: MBE-Room: IV-VI MBE, UHV-STM
R908: AFM-Labororatory: AFM
R910: Crude Chemistry
R4: Cleanroom 4: IV-VI MBE

J. Stangl

R906: X-Ray-Laboratory: Bruker Rotating Anode/Huber Diffractometer
R907: X-Ray-Laboratory: Philips HRD, Philips MRD, Seifert XRD

E. Vorhauer

R007: Electronics shop
R3: Cleanroom 3: Annealer

Geräte-Verantwortliche / Festkörperphysik

Alberta Bonanni

R105:	MOVPE System
R105:	Ellipsometer
R105:	Laser Reflectometer
R208:	UV Lumineszence

Wolfgang Heiss

R2:	Cleanroom 2: Leybold-Optics, deposition chamber
R105:	Tokuda Sputter system
R106:	TePla Plasma reactor
R109:	Brown-Glovebox + flowbox at entrance door
Mi.El:	Cryo-Bind Suszeptometer + Optical equipment for F-Practical
R208:	JEOL-Electron Mikroscope + Nitrogen laser+Infrared-Photoconductivity Equipment + MIR-camera + Pfeiffer turbo molecular pumping station
R212:	Oxford split-coil magnet cryostate + Alcatel turbo molecular pumping station + Spectra Physics Laser system (Millennia+Tsunami) + ps-detection system + pump probe setup + magnetotransport setup
R905:	ELS-Laser system

Kurt Hingerl

R1:	Cleanroom 1: Wafer bonder

Andreas Ney

R010:	ESR and excitation spectroscopy (Opolette, Ti-Sapphire + Ar laser, …)
R206:	DLTS

Reinhold Koch

R204:	IV/IV-cantilever beam magnetometer
R204:	III/V-cantilever beam magnetometer
R204:	Spot welder
R204:	Flowboxes
R4:	Cleanroom 4: Baltec Sputter system
R2:	Cleanroom 2: OEM Scratching machine

Stefan Müllegger

R206:	Low-temperature Scanning tunneling microscope
R206:	Scanning force microscope

Clemens Simbrunner

R105:	3 diffusion pumping stations
R105:	Heraeus tube oven
R105:	3 HWE systems
R105:	Lindberg tube oven + diffusion pumping station
R105:	2-zone oven + pumping station
R105:	Glovebox