University of Glasgow | School of Engineering

# Semiconductor Photonic Materials and Devices Laboratory

## Room 319, Rankine Building

Lab responsible person: Prof. Stephen Sweeney (mob.
Email: Stephen.j.Sweeney@glasgow.ac.uk

## CODE OF PRACTICE

Version 1.0, 28/02/2023 (prepared by Dr Igor Marko)

The adoption and practice of good safety procedures is of paramount importance for both the health and safety of fellow workers, and for the integrity of Semiconductor Photonic Materials and Devices Laboratory.

**All Laboratory Users must read this document in full and sign off in Appendix A**

### 1. LAB SAFETY MANAGEMENT RESPONSIBILITIES

- **Everyone** has a role in protecting the health and safety of both other lab users and themselves, and thus should be familiar with the **School's Safety Manual** https://www.gla.ac.uk/schools/engineering/informationforstaff/safety/ .
- **Academic Supervisors** take full responsibility for the health and safety of their own group's research activities, and consequently must ensure their staff and students are familiar with both the content of this **Code of Practice** and the **School's Safety Manual** and apply its requirements.
- No research activities shall be carried out in Room 319 Rankine Building, without the prior permission of the **Lab Guardian** (Dr Igor Marko).
- No work shall be carried out until a **Risk Assessment** has been conducted by the research staff/students, **approved by their Supervisor** and the **Director of Safety,** and acknowledged by the **Lab Guardian**.
- An **electronic copy** of the approved Risk Assessment shall be sent to the Lab Guardian to be kept as record (note that this can be done using the online risk assessment system). A hard copy of the approved risk assessment shall be displayed next to the relevant research rig and equipment for inspection. The procedures of the preparation of Risk Assessment are summarised in **Appendix B**.
- **All lab users** should make themselves aware of the **general safety procedures** highlighted in the School's Safety Manual and of the location of safety equipment in the lab.

  In case of emergency, dial telephone number: **4444 (internal), 0141 330 4444 (external).**

  **Emergency exits** are accessed through the main lab door via the main building.

The **fire extinguishers** are located in the corridor outside the lab (both in the direction to the left from the lab and to the right, near the lift).

- Work outside normal office hours (including weekend working) requires the permission of your supervisor. This can be given by an e-mail trail for audit purposes in the event of an accident and can be for multiple or extended periods of time. If permitted, the out-of-hours working book located in the foyer of the Rankine building must be signed and the time recorded on arrival and the time of departure. Potentially dangerous operations **must never** be undertaken out-with normal hours **unless a second responsible person is present**. (Please read the safety regulations in the School's Safety Manual for more details.)

**2) PRACTICE OF GENERAL ACTIVITIES**

- The experimental area must be **kept tidy and clean**. Cleaning shall be performed by lab users and only using the dedicated tools. Cleaners are not allowed in the lab.
- Good housekeeping must be maintained by the lab users and be monitored by the responsible person of each area (see Appendix A).
- **Food and drink are not permitted in the lab.**
- The **walkways** leading to the exit must remain clear. Under no circumstances should lab equipment be stored in the route from your place of work to the exit route. If things are possibly impeding your exit then you should either move them, contact the person who placed them there, or inform both the Lab Guardian person and your supervisor.
- **Laboratory doors should remain shut** at all times to ensure security and fire safety.
- Users and visitors will **wear overshoes or the available lab shoes** when entering the lab.
- Activities that may create dust or contaminants, e.g., drilling, **should not be carried out in the lab where possible. Otherwise, special care should be undertaken to avoid contamination of equipment and optical systems.**
- Jackets, overcoats and bags shall be kept outside the inner lab area.
- All items shall be dusted and cleaned before moving them into the lab.
- Equipment must be placed in appropriate locations to safeguard its integrity, minimise potential damage and to allow other researchers access to it.
- Once experimental work has been completed and the experimental setup is no longer required, the **experimental area must be cleared** in preparation for other experiments and researchers.
- If it is necessary to remove equipment from the lab, permission must be given by your supervisor (inform the Lab Guardian). If necessary, seek assistance with moving heavy items. Loans of any equipment either into or out of the lab are to be documented in the loan book.

- If equipment breaks down or is not working, report the fault to your supervisor and the responsible person immediately.
- Any building related fault in the room, such as a lighting failure, air conditioning, water leak, etc. should be reported through the Maintenance Request portal found on the Estates and Commercial Services webpage, http://www.gla.ac.uk/services/estates/ .
- All lasers used are governed by the University of Glasgow Radiation Safety of Laser Products (BS EN 60825: 1992) and/or Guidance on the Safe Use of Lasers in Education and Research (Association of University Radiation Protection Officers Guidance Note No 7: 2012 Revised Edition) as appropriate. Operators shall work in compliance with the General Local System of Work.
- Wear safety goggles and suitable protective clothing appropriate to the laser being used. If in doubt, please ask your supervisor or the Lab Guardian.
- Use equipment in accordance with manufacturer instructions.
- Report any faulty equipment immediately to your supervisor and to the Lab Guardian.
- Access to the lab controlled by user ID card. **Do not allow any unauthorised person in the lab** (authorised persons will have an active and enables access card).
- The lab **air conditioning** system has been provided for optimum operation and maintenance of the laser systems and not for personal comfort. If the air-con system fails, the lab temperature may quickly rise due to the heat output from the laser systems and electronic equipment. This will cause potentially irreparable damage to equipment, many hours of lab downtime, and expensive equipment repair/replacement costs. If any change is noticed in the operation of the lab air-con system, please inform one of the emergency contacts immediately.

**3) PRACTICE OF HAZARDOUS ACTIVITIES**

- **A list of the common activities, their risks, and control measures for Lab 319 are reported in Appendix C.**
- **Electrical connections** between different devices or equipment should be safe. If in doubt, speak with technicians in the Electrical Workshop.
- To minimise **trip hazards**, extension cables should be plugged into the closest socket and avoid crossing pathways. If crossing a pathway is totally unavoidable then, only as a temporary measure, the cable must be secured to the floor and covered with a suitable (commercially supplied) floor cable cover, cable protector, floor cable tidy to prevent tripping hazards. However, leads crossing pathways at the top or bottom of stairways is not allowed, even as a temporary measure – they should be routed at least 2 m (i.e. two paces) away from these areas.

a. Once equipment is not in use, it must be turned off and any extension cables used should be tidied to a suitable location.
b. Leads and plugs should **only** be used on the allocated item of equipment and should **not** be switched between equipment.
c. All equipment plugged into university outlets must be PAT tested (contact the electrical workshop for testing).

- To minimise the risk of **falling objects**, no equipment or lab materials should be kept on top of cupboards and file cabinets, particularly those next to the edge of the upper floor.
- Fire hazards:
  a. All **flammable materials** (gases, liquid and solids) should be stored and handled in accordance to the School's Safety Manual and relevant SEPS guidelines.
  b. All equipment or experimental rigs using flammable materials should be certified and have adequate measures for preventing fire hazards.
  c. All users of flammable gases should be trained.
- Explosion hazards when using compresses gases:
  a. All gas cylinders should be secured to prevent falling.
  b. All pressure vessels should be certified by a professional manufacturer.
  c. All pressure vessels should have measures to preventing over-charging, such as relief valves.
  d. You should seek support from technicians when moving gas cylinders.
  e. All users of compressed gases should be trained.

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**Appendix A: Laboratory Users**

All users of laboratory 319 are required to read and sign this document before using the laboratory.

By signing below I state that I have read and understood the risk assessment and potential hazards in room 319 and will at all times undertake safe practice and abide by the rules in this document. If any equipment is found to be faulty I will immediately report it to Prof Stephen Sweeney and Dr Igor Marko.

| **Name (PRINT)** | **Role** | **Signature** | **Date** |
|---|---|---|---|
| Stephen Sweeney | Supervisor | | |
| Igor Marko | Lab Guardian | | |
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**Appendix B: Procedures of the preparation of the Risk Assessment**

1. PDRAs and PG/UG students are responsible for formulating Risk Assessments on a day-day basis. For potentially hazardous activities, in addition to assessing the risks, the risk assessment form should include a standard operating procedure/method statement (and/or instrument manual) as an appended document.
2. Whilst the preference is for the persons undertaking the practical work to make their own risk assessments, it is permissible to use the on-line multi-user risk assessment forms for activities that will be undertaken by groups of people. However, in this case, each person involved in the practical work must sign the multi-user form online and a strict regime of user training should be in place that encompasses both the risks associated with the work as well as the practicalities of undertaking it.
3. Academic supervisors should assist the PDRAs and PG/UG students in preparing the risk assessment (this would typically be the case for less experienced PDRAs and PG/UG students). They should **ensure** foreseeable risks have been identified and adequate mitigation measures have been provided to reduce them as far as possible.
4. The academic supervisors should then approve the risk assessment form online (or ask for further information to be added); the Lab Responsible should also acknowledge (on-line) that the risk assessment has been completed, to indicate that as far as they can see, this activity does not conflict (in safety terms) with other activities in the lab. The Lab Responsible can also ask for further clarifications/additions concerning the procedures involved to be made, if necessary.
5. After the risk assessment has been approved/acknowledged by the supervisor and Lab Responsible/Lab Guardian, the School's Director of Safety approves, seeks further clarifications, or (exceptionally) rejects the risk assessment if there are clearly hazards that cannot be sufficiently mitigated.
6. An e-copy of the **approved** Risk Assessment should be sent to the Lab Responsible by the PDRA or PG/UG student that originated the assessment (n.b. pdf's of the online form can be made by using the Print to PDF option available in most browsers)
7. A hard copy of the approved Risk Assessment and standard operating procedure should be kept or displayed next to the relevant experimental rig or equipment.
8. The Lab Responsible approves the start of activity after receiving the **approved** Risk Assessment.
9. If there is any substantial change to the people or research activity as stated in the Risk Assessment, it MUST be revised accordingly, and pass procedures 1-7 as above.

**Appendix C: Categories of Activity**

## 1. Use of lasers:

### 1.1. Laser sources

1.1.1. Continuous wave Opus Laser Quantum DPSS laser (Class 4);
- Wavelength: 532 nm;
- Controlled power: 0-2000 mW

1.1.2. Continuous wave Ventus Laser Quantum DPSS laser (Class 4);
- Wavelength: 1064 nm;
- Controlled power: 0-5000 mW

1.1.3. Pulsed Coherent DPSS Laser (Class 4)
- Wavelength: 343 nm;
- Average power: 222 mW
- Pulse duration: 1ns
- Repetition rate: 1-2000 Hz

1.1.4. Pulsed Coherent Laser (Class 4)
- Wavelength: 515 nm;
- Average power: 645 mW
- Pulse duration: 1ns
- Repetition rate: 1-2000 Hz

1.1.5. Pulsed Coherent Laser (Class 4)
- Wavelength: 1030 nm;
- Average power: 1090 mW
- Pulse duration: 1ns
- Repetition rate: 1-2000 Hz

### 1.2. Potential risks

- Eye Safety
- Skin burns
- Fire
- Electric shocks

### 1.3. Control measures

- All commercial lasers and controllers will be PAT tested.
- Door entry warning system and interlocked shutters or power supply interlocks are used when operating the Class 3B or Class 4 lasers
- Laser safety enclosures are used for all Class 3B or Class 4 lasers
- All users will have undergone laser safety training and will follow safety instructions. appropriate laser safety eyewear to be worn during alignment procedures or when enclosures are not closed.

-Alignment procedures undertaken with enclosures not shut to be performed at lowest feasible power.

## 2. Use of Gasses:

### 2.1. Available gasses

- Compressed air
- Nitrogen
- Helium

### 2.2. Potential risks

- Asphyxiation
- Failure of cylinder

### 2.3. Control measures

- Cylinders are securely mounted to wall.
- The main cylinder valve should be closed when not in use.
- All users will undergo gas safety training. Correct tools will be used for mounting or moving the gas cylinder

## 3. Vacuum pumps:

### 3.1. Pumps in use

- Oerlicon/Leybold rotary pumps
- Turbo-molecular Oerlicon pumps

### 3.2. Potential risks

- Electrical shock.
- Damage to pump though exposure to atmospheric pressure.
- Physical damage to pump leading to personal injury.
- Harmful exhaust gases

### 3.3. Control measures

- All pumps will be PAT tested and robustly mounted.
- All users will be trained.
- Vacuum gauges readout will be used to avoid damage to the turbo through overpressure.
- Accessories such as clamps, O-rings, and bellows will be checked regularly and discarded in case of leaks.
- Exhaust filters will be used to avoid harmful exhaust gases inside the room.

## 4. Cryostats

### 4.1. Cryostats in use

- 2 Leybold closed-cycle He-refrigerator cryostats 20-300K
- Oerlikon cold head for high pressure system cryostat using closed-cycle He refrigerator
- 2 Oxford instrument gas-exchange cryostats (77-500K)
- Linkam temperature stage (77-500K)

### 4.2. Potential risks

- Cold burns.

### 4.3. Control measures

- All cryostats are securely mounted.
- All cryostats have thermos-sensors installed and connected to temperature controllers to monitor their temperature. The cryostats will not be opened unless the internal temperature has reached the ambient temperature.
- Cryostats should be used by train users according to their manuals.

## 5. Use of He Compressors, chiller and Cooling Water

### 5.1. Potential risks

- Risk electric shock.
- Risk of flooding leading to electric shock.
- Trip hazard.

### 5.2. Control measures

- All compressors/chiller will be securely mounted.
- Water cooled compressors will be connected to the cooling water with flow rate and temperature set according to manufacturer specifications.
- Robust cooling water pipes will be secured and placed to minimize trip hazards.
- Air cooled compressors/chiller will adequate clearance from walls and neighbouring apparatus to allow air flow.
- Cooling water system will be monitored regularly for flow rates and leaks.
- All users will be given basic instruction in starting and restarting the cooling water.

## 6. Electrical equipment

### 6.1. Potential risks

- Risk electric shock.
- Fire.

### 6.2. Control measures

- All electrical equipment is PAT tested.
- Instrument housing will not be removed when the equipment is connected to the power supply.
- A grounding strap should be used when handling or modifying delicate electronics (e.g. amplifiers).

## 7. Use of chemicals (solvents, adhesives, conductive silver paste, solder flux)

### 7.1. Potential risks

- Flammable, irritant, toxic.

### 7.2. Control measures

- All users must read and sign corresponding CoSHH forms
- Less than 200 ml bottles to be kept in the lab.
- Bigger storage bottles will be kept in a metal chemicals' cabinet.

- All flammable chemicals will be kept away from soldering irons and other heat sources.
- Disposal will be carried out according to building chemical disposal procedures.
- Minimum quantities of solvents/adhesive will be used using protective gloves and glasses.

## 8. Other equipment (power drill, soldering iron, heat gun)

### 8.1. Potential risks

- Electric shock.
- Injuries.
- Burns.
- Fire.

### 8.2. Control measures

- All tools/equipment are PAT tested
- Users should be trained and care to be taken when setting up and handling the tools.
- The soldering iron will not be left on unattended. The power will be switched off when changing tips. The extractor fan will be used to mitigate fumes.
- The heat gun will be PAT tested. It will not be left running unattended. It will not be operated in the vicinity of flammable solvents. It will not be directed at bare skin.