

*Institute of Physical Chemistry  
Nanostructured Model Catalysts Group  
Responsible Group Leaders  
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*The following safety instructions are to be read  
by all group members; a signed printout of this  
file has to be provided a.s.a.p. for  
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Issue date: 22/12/2017*

## **Safety Rules for Working with Electrical Equipment**

**Initial, most important remark: before you start to work on electrical equipment (i.e. before switching on), make sure that all connectors, feedthroughs and any current-conducting/ non-insulating construction parts are covered by protective insulating safety shields. This holds especially when using high voltage equipment.**

**If you realize that there is any chance to accidentally touch „live“ metallic/conducting construction parts (like feedthroughs, blank wires or their non-insulated ends etc...), DO NOT SWITCH ON !**

**You are obliged to ask your supervisor (Dr. Klötzer or Dr. Penner) to check your whole experimental assembly for chances to accidentally touch such unprotected areas.**

**Do not start to work with high-voltage instrumentation unless your supervisor pre-checked your safety measures !**

**Moreover, the appropriate shieldings and warning signs have to be installed in the appropriate places !**



A safe work environment is not always enough to control all potential electrical hazards. You must be very cautious and work safely. Safety rules help you control your and others risk of injury or death from workplace

hazards. If you are working on electrical circuits or with electrical tools and equipment, you need to use following golden safety rules:

Rule no. 1

Avoid contact with energized electrical circuits. Please don't make fun of this rule if you already know this and remember that if something bad occurs – you probably won't have second chance.

Rule no. 2

Treat all electrical devices as if they are live or energized. You never know.

Rule no. 3

Disconnect the power source before attempting to service or repair electrical equipment. Don't do anything yourself, first ask your supervisor how to proceed. Electrical repairs and servicing should in any case be performed by trained personnel such as the department's electronics engineer.

Rule no. 4

Use only tools and equipment with non-conducting handles when working on electrical equipment.

Rule no. 5

Never use metallic pencils or rulers, or wear rings or metal watchbands when working with electrical equipment. This rule is very easy to forget, especially when you are showing some electrical part pointing with metallic pencil.

Rule no. 6

Never handle equipment that is plugged in. If you are not sure if you might touch live parts of your equipment, wear nonconductive gloves, and shoes with insulated soles. Remember: gloves and shoes.

Rule no. 7

In case of potentially live parts, work with only one hand, keeping the other hand at your side or in your pocket, away from all conductive material. This precaution reduces the likelihood of accidents that result in current passing through the chest cavity. If you ever read about current passing through human body you will know, so remember – work with one hand only.

Self reading:

Do You Understand What Is Electric Shock?

What psychological effect does an electric shock?

Rule no. 8

Minimize the use of electrical equipment in cold rooms or other areas where condensation is likely. If equipment must be used in such areas, mount the equipment on a wall or vertical panel.

Rule no. 9

If water or a chemical is spilled onto equipment, shut off power at the main switch or circuit breaker and unplug the equipment. NEVER try to remove water or similar from equipment while energized.

Rule no. 10

If an individual comes in contact with a live electrical conductor, do not touch the equipment, cord or person. Disconnect the power source from the circuit breaker or pull out the plug using a leather belt. You must be very calm in order not to make the situation even worse.

Like in previous rules – Always disconnect the power FIRST !

Rule no. 11

Equipment producing a “tingle” should be disconnected and reported promptly for repair.

Rule no. 12

Do not rely on grounding to mask a defective circuit - do not try to „overrule“ the fault current circuit breaker. Do not attempt to correct a fault by insertion of another fuse or breaker, particularly one of larger capacity.

Rule no. 13

Mind that capacitors (e.g. interference suppression capacitors with high capacity) need to be drained professionally (i.e. not by you !) before touching the cover of your instrument. You might accidentally touch the terminals during the work, resulting in massive electrical shock. If you do not fully understand this rule, ask your supervisor which instruments are affected.

Rule no. 14

Never touch another person's equipment or electrical control devices unless instructed to do so.

Rule no. 15

Enclose all electric contacts and conductors so that no one can accidentally come into contact with them. If applicable do it always, if not be very careful.

Rule no. 16

Never handle electrical equipment when hands, feet, or body are wet or perspiring, or when standing on a wet floor. Remember: Gloves and Shoes.

Rule no. 17

When it is necessary to touch electrical equipment (for example, when checking for overheated motors), use the back of the hand. Thus, if accidental shock were to cause muscular contraction, you would not “freeze” to the conductor.

Rule no. 18

Do not store highly flammable liquids near electrical equipment.

Rule no. 19

Provide interlocks on equipment which disconnect the high voltage source if e.g. a protective cover is removed. Mind that power for control circuits may still remain on, despite the interlock operation.

Rule no. 20

De-energize open experimental circuits and equipment to be left unattended.

Rule no. 21

Do not wear loose clothing or ties near electrical equipment.

## **Safety in the Chemical Laboratory:**

A considerable part of the work in a chemistry laboratory involves using materials and processes that can be dangerous if not properly handled. With careful preparation beforehand and careful use of chemicals and equipment, accidents can be avoided. Lack of intelligent preparation and careless use of chemicals and equipment can be extremely hazardous, even fatal. Therefore, you must learn to work intelligently and take the proper precautions for each individual experiment. These need to be worked out specifically before any individual hazardous operation.

The following are some general rules for safe laboratory practice.

Most important:

- 1.** ALWAYS wear eye protection.
- 2.** DO NOT wear sandals or open-topped or toe shoes.
- 3.** If you have long, baggy sleeves roll them up or bind them close.
- 4.** DO NOT wear nylon hose.

### **Preparation**

Before coming to the laboratory, study the experiment and try to understand the procedure that you will be performing. Make a special note of any safety precautions. At times there might be parts that you don't understand. Be prepared to ask your supervisor about these.

The most important reason for adequate preparation is to be able to work efficiently and thus safely in the laboratory.

### **Personal Protective Equipment (PPE)**

All personnel in the laboratory must wear *safety goggles* when anyone is working with chemical in the lab. This includes when a student across the lab is still working with chemicals even though you have finished your experiment for the day. This simple precaution can eliminate the danger of eye injury caused by you or your neighbor spattering chemicals or breaking glass. Another important protection for your eyes is to avoid rubbing your fingers in or near your eyes. Chemicals can easily be transferred from your hands to your eyes in this way.

All personnel is required to wear a *lab coat* at all times when anyone is working with chemicals in the lab. A lab coat is more than a uniform identifying you as a scientist; it affords you some protection from spills of hot or corrosive materials as well as protecting your regular clothing. Use common sense in choosing the clothes that you wear to the laboratory. Loose clothing may be more susceptible to catching on fire and may also cause accidental spills.

Never wear sandals or open-toed shoes in the laboratory. This is a strict requirement. Feet are especially vulnerable to anything that falls.

There is some controversy about wearing contact lenses in a chemical laboratory. In general, it is better to wear eyeglasses if you have them. Be sure to change from contacts to glasses in enough time to allow your eyes to adapt to the glasses by the start of the lab. If you must wear contacts be especially careful to wear goggles at all times and do not touch your eyes with fingers. Chemicals can get behind the lens, between it and your eye. This is very dangerous because the lens holds the chemical in contact with the eye. The lens also obstructs the cleaning of the eye and becomes difficult to remove because the eye muscles tighten in this situation. In extreme cases the contact lens can fuse to your eye.

### **Response to Accidental Contact**

Avoid all direct contact between any part of your body and chemicals. Goggles, lab coats, full shoes and gloves decrease the chances of accidental contact. Some chemicals are quite innocuous while some chemicals are very hazardous. Whenever direct bodily contact is made with hazardous or unknown chemicals, the top priority is to remove the chemical and limit exposure. This is most often accomplished by **immediately removing any contaminated clothing and washing all exposed body parts**. If some chemical splashed on one's hand, arm or foot, immediately go to the sink and wash with copious amounts of soap and water. If chemicals splashed on one's lab coat, remove the lab coat. If hazardous chemicals seeped through the coat onto underlying clothing, remove that clothing. If chemicals are on one's body, proceed to the safety shower and pull the ring. If any chemical enters one's eye, proceed to the nearest eye wash and flush eyes for a full 15 minutes.

### **Hazardous Chemicals**

There are many different kinds of hazards associated with various chemicals. Many chemicals are *flammable*; that is, they can catch on fire. Some flammable chemicals catch fire rather easily; others are not so susceptible. Some common

flammable chemicals include low molecular weight ethers, alcohols, and hydrocarbons.

Some chemicals are *carcinogens* or cancer-causing agents. *Mutagens* cause mutations, which are inheritable changes in the genetic material. *Teratogens* cause birth defects. *Lachrymators* cause tearing and intense eye irritation. There are chemicals that are *explosive*. Some are *corrosive* and can cause visible destruction of skin and clothing. Others irritate the skin in other ways.

Some chemicals that are relatively harmless individually become hazardous when mixed together. *Toxic* materials cause sickness or death when inhaled, ingested or absorbed.

Many common chemicals have one or more of these properties, so treat any chemical that you do not know about as potentially dangerous. The key is to look up chemical hazards ahead of time. If being in doubt, use the **Material Safety Data Sheet (MSDS)** of each individual compound. All MSDS are readily available in the internet, specifically at the homepage of your chemical supplier (e.g. Sigma Aldrich). Handle chemicals in accordance with the information you find, and be especially cautious with unknown materials.

Reduce the possibility of fire by eliminating the use of open flames for heating. Never use an open flame in an organic chemistry laboratory in which flammable solvents are in use. Nevertheless, the alternative sand baths, Mel-Temps, and hot plates become extremely hot, so beware of touching the surfaces of these items and of spilling flammable solvents or solutions on them. Be especially wary of the sand. Hot sand can cause severe burns and it does not look any different from cold sand. Do not allow any laboratory chemicals to come in contact with your skin. If you do get a chemical on your skin, immediately wash with large quantities of water. Clean up chemical spills on bench tops and balances as soon as they occur. These are common sources of chemicals that get on the skin. (Besides that, the balances are sensitive electronic instruments that are easily damaged by spilled chemicals getting into their interiors.) Be especially careful of concentrated acids and bases. *Mercury spills from broken mercury thermometers are especially dangerous and need to be collected immediately using appropriate equipment.* If any chemicals get into your eyes, flush them out immediately with large quantities of water from the eye wash fountain or saline solution from an eye wash bottle. Flushing should be continued for fifteen minutes and then prompt medical attention should be obtained.

Some chemical operations produce poisonous or irritating gases. When this is the case, the operation should be carried out in a working fume hood or with an appropriate trap. The hoods are most effective when the sash is closed. Only open them high enough to work in and lower them when you finish.

Never eat or drink in the laboratory. Do not even bring food or beverages into the laboratory or store them there.

#### **Disposal of Excess or Used Materials**

In any individual experiment case, the applicable instructions for disposal of the used chemicals need to be extracted from the literature/internet/ MSDS.

The following are some general guidelines regarding the handling of surplus materials.

One of the simplest ways to reduce the amount of waste is: ***take no more material than you need from the container.*** Once you have removed a chemical from its original container, it must be considered contaminated and should not be returned to the container. ***Do not leave the excess lying around near the balances or elsewhere in the laboratory.*** Also, to minimize contamination as well as unpleasant odors, put the lids back on all reagent containers immediately.

Never put any solids in the sink. This includes filter paper, litmus paper, boiling chips, and sand as well as surplus solid chemicals. Place critical waste solid and liquid chemicals and reaction products in a container placed in a fume hood in an appropriate container. **Glass is in a class by itself.** Never put any broken glass item in a sink or waste basket. Special „glass-only“ boxes need to be provided in the laboratory for glass that is broken or must be disposed of for other reasons.

A few liquids can be disposed of in the sink. Small samples of non-poisonous dilute acids and bases are in this category. Concentrated acids and bases must be first diluted and neutralized, if necessary, before disposing of them in the sink. When diluting acids or bases remember to add them to water, not vice versa. In all cases in which materials can be disposed of in the sink, they must be flushed down the drain with a large quantity of water.

### **Safety and First Aid Equipment**

The laboratory is equipped with several pieces of safety equipment. Your instructor will point out all of their locations and demonstrate the use of some of them. This equipment includes *fire extinguishers*, a *safety shower*, one or more *eye wash fountains*, and *first aid supplies*. Know where all of these items are located and how to use them. It is too late to learn at the time that they are needed. You must know ahead of time.

Immediately report all accidents, no matter how minor, to your instructor. In the event that your instructor is unable to assist you in an emergency, contact the responsible institute/department contact person, or another chemistry faculty member. **You should pin a sheet of paper with all emergency numbers and the official contact persons to a well-visible area in your lab.**

**CHEMICAL SPILLS ON YOUR BODY - Remember that speed in washing to remove the chemical is most important in reducing the extent of injury.** If you spill a chemical on your arms or hands, or notice a burning sensation on your arm or hands, go IMMEDIATELY to the nearest sink and wash the affected area with copious amounts of soap and water. If you spill a large amount of chemicals on your body, remove your lab coat, if the spill went through to your clothes then go to nearest safety shower and douse yourself fully. Remove any contaminated clothing. Remain in the shower until all chemicals have been washed away.

**CHEMICALS IN EYES** – If a chemical gets splashed into your eyes, immediately go to the nearest eye wash station and while holding your eye open, irrigate the eye completely for at least 15 minutes. Your colleagues should then ensure an escort is provided to the nearest health center

**ALLERGY/CHEMICAL SENSITIVITY-** – Due to the possibility of contact with chemicals, please self-notify your colleagues/ safety responsables if you have a known allergy or have a known chemical sensitivity or if you develop any of these conditions. Additional safety equipment (such as gloves) should then be used. In specific cases it might be better to stay off from certain experiments.

**PREGNANCY-** Some materials used in chemistry laboratories are potentially hazardous to human health, especially if used incorrectly or in certain situations. Risks to the fetus during pregnancy may be different or greater than the common hazards. If you are pregnant or become pregnant during the semester, immediately consult with your doctor about whether or not you should perform certain experiments.



**HEALTH CONDITIONS-** If you have a condition that may impact the safety of yourself or others in the lab (such as fainting spells, seizures, tremors, etc) notify your instructor. Special safety practices may be put in place.

**EYE PROTECTION** - Safety goggles must be worn at all times when you or anyone else is actively working with chemicals in the laboratory. The safety goggles must have full side shields. Do not remove your safety goggles once an experiment has begun. Avoid rubbing your fingers in or near your eyes when working in the lab.

**FOOT PROTECTION-** Only closed topped and closed toe shoes must be worn when working in the laboratory. If you look down and see a swath of skin showing, your shoes are not appropriate. Shoes should fully cover the top of ones feet. Shoes with holes (Crocs) or mesh are not allowed.

**BODY PROTECTION-** Students are required to wear a lab coat when working in the laboratory. A lab coat provides an added layer of protection between your skin and any spills. These are available for purchase in NCF 362. Avoid wearing loose sleeves or other clothing which may drag in chemicals or catch on equipment.

**CHEMICAL HEALTH HAZARDS-** Chemicals can have more than one associated health hazard. Some common types of hazardous chemicals include carcinogens (cause cancer), mutagens (damage chromosomes), irritants, corrosives (cause destruction of tissue on contact), teratogen (cause birth defects), and other toxic agents (cause sickness or death through ingestion, inhalation or dermal contact). Treat all unknown materials as if they were very hazardous.

**CHEMICAL SPILLS.** All chemical spills should be cleaned up immediately by the proper procedure (if you do not know the correct procedure, ask for support by your supervisor or by a responsible safety contact person.

**PIPETTING LIQUIDS** - Always use a rubber suction bulb or a syringe attached to the pipette to fill the pipette. Keep pipette in vertical position when using to prevent fluid from rolling back into bulb and contaminating next material used. NEVER USE YOUR MOUTH TO DO THE WORK OF THE SUCTION BULB OR SYRINGE.

**HEATING MATERIALS-** Make sure that a boiling stone or stir bar is contained in all liquids before heating. When heating materials in a test tube, always point the opening of the container away from yourself and other persons in the area. Point the opening toward the back of the hood or up toward the splash guard that runs the length of the work bench. Never heat a closed (sealed) container. Never place your face over a material which is being heated. This includes liquids or solids, beakers, test tubes, and Erlenmeyer flasks. If the material “bumps”, the hot fluid can shoot out and cause chemical and/or thermal burns.

**CONDITIONS OF YOUR WORK AREA** - You should maintain a work area that is free of unnecessary clutter. Store all books, coats, purses, etc. in your office. At conclusion of the experiment, replace all equipment to proper location, and wash all glassware (with soap and brush). If glassware does not come clean with soap and water, rinse with acetone. Do not leave any glassware in sink or other locations around the lab. Wipe up your work area after you conclude your work.

**EATING OR DRINKING** - Since there is a possibility of food substance becoming contaminated with toxic chemicals, no eating or drinking will be allowed in the laboratory. No chewing gum and no hard candy. Do not put on lipstick or make-up in lab. Never taste any chemicals from the laboratory. Do not have any bottles of consumable liquids out in the laboratory. (This includes bottled water.)

**SMOKING** - Smoking is not allowed in any building on campus.

**FIRE IN THE LABORATORY** – In the event of a fire, call out “FIRE” and get away from the fire. Notify the next faculty member(s) and call the applicable emergency number. Small, self-contained fires with limited fuel source may be extinguished by covering with a watch glass or simply allowing it to burn itself out. Small to Medium fires may be extinguished by the yourself using a fire extinguisher located in the lab. Medium to Large fires demand immediate evacuation of the building. Pull the fire alarm, then immediately evacuate the building.

**EVACUATION**- In case of evacuation, leave room immediately by nearest exit and proceed down the nearest stairs. Do not use the elevator.

**FIRE ON A PERSON** - If your clothing or hair catches fire, DO NOT RUN. Running only fans the flames. Go immediately to and use the safety shower and call out for help. Stay under the shower until the fire is out and the skin temperature has cooled down. If you are in a lab where a person is on fire, it is your responsibility to help that person get under the safety shower and assist them in any way that you can. NEVER USE A FIRE EXTINGUISHER ON A PERSON.

**UNFAMILIAR CHEMICALS** - Never use a chemical from an unlabeled container. Always treat unfamiliar chemicals as if they are dangerous.

**FUME HOOD:** Never place any body part other than your hands inside the fume hood. When working in fume hood, keep the sash line between you and the material being manipulated.

**A person who is familiar with the material on laboratory safety should be able to:**

1. Define, recognize, and give examples of each of the following: carcinogen, teratogen, mutagen, lachrymator, corrosive, flammable, inflammable, nonflammable.
2. Describe when and how each of the following should be used: safety goggles, lab coat, fume hood, eyewash fountain, safety shower, fire extinguisher.
3. Identify the procedures for disposal of waste in the laboratory. Classifications can include: halogenated and nonhalogenated organic liquids, halogenated and nonhalogenated organic solids, broken glass, acids and bases, and ordinary (nontoxic) trash. (Additional classifications may be added for subsequent experiments).
4. Give and recognize the procedures for dealing with the following laboratory emergencies: fire, whether on a person or not; chemical spills on the floor or desktop, on a person's skin or lab coat, and in a person's eyes; cuts; burns.
5. Carry out all of the assigned experiments in this laboratory safely, with knowledge of the material in this section in mind.

**Confirmation of Receipt, of complete Reading and Understanding of Safety Instructions:**

**Name and Signature:**

**Date:**