User guide for Laboratorio di Ateneo

PoliFAB

Building 30, via G. Colombo 81, 20133 - Milano

Chemical agents

General description

In Polifab, chemical agents of different kinds are daily in use. Aim of the present document is to inform the users about the chemical danger teach them about the safety procedures currently in use in the laboratory. In the following table we show the list of chemicals that are more commonly used in Polifab, together with the hazard H and the hazard description.

Chemical agent	Hazard H
Acetone	225 - 319 - 336 - EUH066
Isopropanol	225 - 319 - 336
Fluoridric acid	300 - 310 - 314 - 330 - EUH071
Chloridric acid	280 - 314 - 331
Sulfuric acid	314 - 290
Phosphoric acid	314 - 290
Nitric acid	272 - 311 - 314 - 330
Ammonium fluoride	331 - 311 - 301
Ammonium fluoride – HF mix (BOE)	H301 - H331 - H310 - H314
Potassium hydroxide	314 - 302 - 290
AZ 100 remover	290 - 314
AZ 726 MIF	290 - 302 - 312 - 314 - 371 - 373
AZ 1505	226
AZ 5214E	226
TI Prime	226
Ammonia solution	314 - 335 - 336 - 400
HMDS	225 - 302 - 311 - 314 - 412
TMAH 25%	301 - 311 - 314
Ammonium hydroxide solution	302 - 314 - 335 - 400
4-Metil-2-Pentanone	225 - 319 - 332 - 335
Remover AR 300-70 (NEP)	318
AR-P 7400	226 - 302 - 312 - 319
AZ 400 K Developer	290 - 314
Hydrogen peroxide	271 - 302 - 314 - 332 - 335
Ethanol	225

Hazard H	Hazard description
225	Highly flammable liquid and vapour
226	Flammable liquid and vapour
271	May cause fire or explosion; strong oxidiser
272	May intensify fire; oxidiser
280	Contains gas under pressure; may explode if heated
290	May be corrosive to metals
300	Fatal if swallowed
301	Toxic if swallowed
302	Harmful if swallowed
310	Fatal in contact with skin
311	Toxic in contact with skin
312	Harmful in contact with skin
314	Causes severe skin burns and eye damage
318	Causes serious eye damage
319	Causes serious eye irritation
330	Fatal if inhaled
331	Toxic if inhaled
332	Harmful if inhaled
335	May cause respiratory irritation
336	May cause drowsiness or dizziness
371	May cause damage to organs
373	May cause damage to organs through prolonged or repeated exposure
400	Very toxic to aquatic life
412	Harmful to aquatic life with long lasting effects
EUH066	Repeated exposure may cause skin dryness or cracking

The use of the chemical agents mentioned above and, in general, of any chemical agent has to be performed in complete safety for the users. It is therefore mandatory to use the suitable individual protections (DPI) and work only under a chemical bench. **Every operator has to know the hazard connected by the agent in use and the first aid measures in case of accident.** Moreover, it is necessary to choose the most appropriate DPI: for example, in the case of acetone and isopropanol, glasses and latex gloves are enough, while for HF, a mask, nitrile

gloves and chemical protective suit will be necessary. On the PoliFAB website, in the page "Processes", visible only after login, you can download the Material Safety Datasheet (MSDS) of the substances present in Polifab. **Before the use, each person has to carefully read this documentation in order to operate in complete safety, even in case of accidents. Users cannot introduce in the cleanroom other chemical agents without informing the Staff and being authorized by a written email.**

In Polifab, 8 chemical benches are installed for the exclusive use of chemicals. In the following table we list them together with their placement in the lab and their main usage in terms of chemical agents.

Name	Position	Usage
Development bench	Yellow room	Solvents, developer (bases)
Spinner/hotplates bench	Yellow room	Resist, solvents
Single-wafer bench	Wet area	Acids, bases
Multipurpose bench	Wet area	Acids, bases (right), solvents (left)
Lift-off bench	Wet area	Solvents
PDMS bench	Back-end	Solvents, PDMS
Spinner bench	Back-end	Solvents, PDMS, Polyimide
Magnetic thin films bench	Magnetic thin films	Solvents, Galvanic solutions

Chemical agents are stocked in 6 dedicated storage cupboards under ventilation, as described in the table below:

Name	Position	Usage
Acids cupboard	Grey corridor	Acids
Solvents cupboard	Grey corridor	Solvents
Bases cupboard	Grey corridor	Bases and other chemicals
Lithography cupboard	Yellow room	Developer, stripper, solvents
Multipurpose cupboard	Wet area	Acids, bases, solvents (small quantities)
Waste cupboard	Grey corridor	Waste

Two refrigerators are also present in the yellow room, where resists and other materials that must be stored under cooling are stocked. Other resists that don't need to be kept in the refrigerator can be stored in the Lithography cupboard in the yellow room.

For the work under every wet bench, independently of the chemical agent in use, users must wear personal protective equipment (PPE or DPI). PPE/DPI are: glasses, facial masks gloves, chemical protective coat. In the lab, two safety showers with eye wash are installed for the emergency; one in wet are and one in the grey corridor.

Operative instructions

The usage of chemicals is permitted only under wet bench. Before using the wet benches the user has to confirm that this is ON and that, where installed, the green light is present. In case the red light is on and/or the bench is off, the operations are not allowed. In this case, please inform the Staff. Where present, an indicator (Magnehelic) shows the difference in pressure between the room and the area under the wet bench. Only if it shows a value higher than 10 mm of H_2O, the users can operate safely. **The user always must confirm that the working space**

under the bench is clean and safe. On every wet bench window, a red mark is clearly drawn with the indication of "Maximum Operating Level", meaning that this is the maximum opening of the window to ensure a complete safe operation for the users in terms of air speed at the bench front. During the usage of chemicals it is forbidden to open the window more than what is indicated. Finally, PPE/DPI must be used when using chemical agents under the wet bench. In summary, before using a wet bench, it is mandatory to: confirm that the wet bench in ON (light in ON), check the exhaust system is ok (Magnehelic, if present, no red light), control that the space is clean and safe, open the window not more than the limit and wear PPE/DPI.

Two different operation modes can be defined for the work with chemical benches. In the first case the large baths, which can accommodate a cassette with 25 wafers are used. The Staff has to be informed and will take care of filling and wasting the baths, because of the large quantities of chemicals involved. In the second case, beckers/Petri dish for small samples/singe wafer are used and each person can work without a member of the Staff being present. **The only exception is HF, for the use of which, we require a second person to be present.**

At the end of the operations, the wet benches must be left in perfect state of cleanness and order. It is forbidden to leave chemicals of any type under the wet benches, therefore reagents have to be put in the storage cupboards after every use. In the case an users needs to leave a becker under the wet bench unattended, a message should be left with: Name and surname of the user, name of the chemical and time when he/she left. At the end of the job, always remember to completely close the windows.

Chemical waste has to be collected into dedicated bottles that can be found in the storage cupboards, taking care that only similar substances are mixed. When a bottle containing a chemical product is finished, the users must: rinse it with water repeatedly, remove the original label and place it in the dedicated cupboard. **To facilitate the waste procedures, chemicals of similar properties have been gathered into 3 groups, identified by a color: Solvents-BLACK, Basic-GREEN, Acid-ORANGE.** For acids waste, there is an automatic drain system, that can be used by the Staff upon request. **In the case of wasting a Piranha solution or other gas developing solutions, it is necessary to: wait at least 4 hours before the waste and dilute the solution in a volume of water at least equal to the one of the solution to be wasted.** Waste bottles must be clearly identified by the color, warping them around with the suitable colored tape. Consult the Staff when you need to create a new bottle for the waste. If the chemical to be disposed is not in those 3 groups, consult the Staff. Finally, wet benches are equipped with DI water rinse baths (typically in the front). Do not waste chemicals in those baths, as they are meant to drain only pure water or small amounts of rinsed chemicals.

Emergency

In case of accident during the operations the users have to behave maintaining the highest safety for themselves and the others. Even in case of accidents without consequences to people or instruments users have to report about it to the cleanroom Staff. Users also have to keep the Staff informed about situations that can be potentially harmful for users safety or that are in disagreement with the instructions present in the present and in the other instruction and safety documents.

In case of outpouring of chemical agents, if the chemical is not dangerous and the quantity not significant, wipe and clean by cleanroom paper wipes present in every chemical bench, waste

them in the appropriate waste bin and inform the Staff. If the agent is dangerous or the quantity significant, ascertain that the working place can be left in safety and call the Staff.

In case of health emergency, defined as any situation where one or more users show (even small) health problems, it is necessary to evaluate the danger. Only after a careful evaluation it is possible to proceed, helping the injured person(s). At the same time users have to inform the Staff. In the case of potential danger for other users, activate the fire alarm. If no Staff personal is available it is possible to call Portineria Centrale of Politecnico (2006) and, only if also there nobody replies, call 118.

In case of fire, activate the fire alarm by the dedicated button and inform the Staff. If the fire alarm is heard, immediately leave the working place, evacuate through the closest emergency exit and reach the collection point. In case the emergency exit of the cleanroom is blocked or the access through it not possible, it is recommended to leave the cleanroom via the first air-lock, leaving its two doors open for the other users.

Examples of accidents

The following two pictures show, as an example, two cases of skin burn caused by fluoridric acid (on the right) and sulfuric acid (on the left).

A cream based on Calcium Gluconate can be found in the transparent cupboard in Wet area. This is very effective against HF burns.

Attachments

Attached to these documents are: a table with a glove resistance chart, where depending on the chemicals, the resistance of different type (material) of gloves is reported and a list of some of the most commonly used chemicals with the waste family/color indication.