Professor Chun-Hu Chen Laboratory Manual

This manual is also an Independent Study textbook, so please memorize it. If you fail the exam, you cannot pass the course.

2026.10.16

Lab Rule

1. No **goggles**, no entry in the lab.
2. The **floor** and **benches** must be maintained **clean** at all times. Remove all the trash and items when you finish the experiments.
3. Each bench in the lab may have an area labeled **by yellow tape**, you may leave your lab belongings in this area for your temporary convenience. The other area is to conduct experiments only, so you must clean it when you finish the experiments. No experiments items to be left in this area.
4. The electrochemical bench is **only** for electrochemical measurement and experiment, other works are not allowed.
5. When someone is working on the electrochemical bench for testing stability, please take items from the bench carefully.
6. Don’t leave anything on the top of CVD bench.
7. Please maintain the hood closed at all times.
8. Please clean the hood after doing experiments in it and maintain cleanliness of hoods at all times.
9. For the last person leaving the lab, please turn off all the air conditioners.
10. If you are the last one leaving the lab and there’s no work in the public computer and instruments, please turn off them before you leave.

Please Pay Attention to The Following Points:

1. Recycle any samples you send for testing (especially those you report on each week).
2. Doing inappropriate laboratory activities (such as playing cards, watching YouTube, and drinking) is forbidden.
3. All research-related information, original data, references, presentations, pictures, etc., must be updated to the laboratory's Google Cloud.
4. The laboratory manual will be used as the exam content, and the scores will be included in the Independent Study score criteria. If you fail the exam, you cannot pass the course.

Laboratory Environmental Safety and Health Regulations

Safety Regulations:

1. Before entering the laboratory, please wear long pants, cloth shoes (no slippers), goggles, and gloves.
2. If the experiment has safety concerns, please confirm with the person in charge of safety whether the experiment can be carried out.
3. If you find liquid (water, acid, or other solvents) on the floor, please wipe it clean.
4. The waste tank can only be filled to 80%. Otherwise, there will be leakage problems.
5. Waste tanks should be labeled and placed in waterproof containers.
6. If using CVD, only 5% hydrogen of the total gas volume can be used.
7. If a gas cylinder is used in the experiment, pay attention to whether there is any leakage problem in the gas cylinder. If the gas valve is closed, but the pointer of the pressure gauge on the left (the gas outflow pressure) does not point to 0, there is a leakage problem, and the pressure gauge needs to be repaired. You can contact the gas cylinder manufacturer for repair or find someone outside to fix it yourself.
8. Please don't place the wrench on the cylinder to avoid changing the status of the cylinder switch due to collision and other factors.
9. During winter and summer vacations, all members must count the drugs together.
10. Remember to turn off all instruments after the experiment is completed.
11. The last person leaving the laboratory must check whether the windows are closed (to prevent monkey intrusion), pull down the windows of the hood, and lock the door.

12. Clean used chemical cans internally and remove the external labels. Place them in the empty bottle area outside the laboratory. Remember to ask the manufacturer to take away all used chemical cans.
13. If you want to use, purchase, borrow, or lend toxic and concerned chemical substances, please report it to the person in charge of safety.
14. When doing experiments in the evening or on weekends, at least two students must be in the laboratory.
15. When using volatile chemicals, toxic chemicals, and more dangerous reactions must be used in a hood.
16. Suppose you enter the laboratory more than three times without wearing goggles. You will be confiscated the right to use the laboratory for one week, and the corresponding scholarship will be deducted. If the offense occurs again, you will forfeit the use of the lounge for one week. If you want to take a break, please go to Prof. Chen's office and sit with the teacher.
17. If you need to conduct new experiments or use new chemicals in the existing process, please make sure to provide the following information in advance for the person in charge of safety: a detailed description of the experimental process, the specific quantities of chemicals used, and the Material Safety Data Sheets (MSDS) for all related chemicals. Please discuss and confirm with the person in charge of safety before proceeding with the experiment to ensure operational safety.

Health Regulations:

1. Except for the areas marked with yellow tape, personal experimental items, and samples are not allowed to be placed in the work area. Please clean them up after the experiment. If they are not adequately tidied up, you must stay on duty for a week.
2. After using the balance, please remove the leaked chemicals and keep it clean to prevent corrosion.
3. Please put the tweezers with the tip down after use to avoid being stabbed by the following user.
4. Do not leave empty containers in the sink after use. Please clean them and hang them on a shelf above the sink.
5. Keep the aisles clear, and do not place items randomly.
6. Please clearly label the samples in the oven and do not place them randomly.
7. All members must clean the lab during winter and summer vacations.
8. If you will not be doing experiments for a long time, please put your shoes in the shoe cabinet to avoid interfering with laboratory operations.

Laboratory on-duty Regulations:

1. Pour out the water from the dehumidifier in the laboratory of the science building **every day** and inspect for any abnormalities.
2. Keep the laboratory clean (including the **balance,** hood, experimental table, etc.), and **inspect the environment before leaving every day.**
3. Garbage is not allowed to exceed the yellow line. Must take out garbage once a day, and the floor must be swept and mopped (laboratories and restrooms).
4. Supplement deionized water.
5. Clean the air-conditioning filter at the beginning of the month.

Rules for Ordering Chemical/Equipment (Unified Business No.: 76211194, Heading: National Sun Yat-sen University)

1. Please first request quotations, compare prices, and ask for discounts. Fill out the online form with the chemicals or equipment want to order, and proceed with the purchase only after Prof. Chen confirms. The purchasing action can be carried out either by yourself or by an authorized representative. After the goods arrive, please submit the invoice (receipt) or delivery note and related documents to the responsible student for online registration.

   Current responsible students: Hong-In (in charge of reimbursements, postage, and instruments), Hong-Han (in charge of all vendors).

2. The order must affix the following information on the chemical packaging with label paper.
   Name of the order, manufacturer of the chemical, date of order, name of the chemical
3. Except for UNI-ONWARD Corp., which must attach an invoice, other manufacturers try to take out the delivery note first. The following vendors currently allow purchases on account: Li-Wen Bookstore, LONG WHA ENTERPRISE CO., Jing. Shang. Enterprise. Co., ECHO CHEMICAL CO., LTD., and the

College of Science Welfare Store.

4. Avoid ordering items from Shuangjin (Yihe) and Chengxin (because the price is more expensive).
5. Don’t purchase with Jinde; mainly, order gas cylinders from Jingshang.
6. Order goggles: Youjia 06-2335500. When ordering, you need to ask him to write the Unified Business on the purchase certificate for the freight. Otherwise, the freight cannot be reimbursed. If you buy more, ask him if you can directly pay the manufacturer.
7. The reimbursement amount should not exceed NT$3,000, and remember to write the person's name on the invoice.
8. Before taking petty cash, you must first ask Prof. Chen. For amounts over NT$5,000, prior approval from the professor is required. For amounts under NT$5,000, you may go directly to Angela to collect it.
9. Payments at Li-Wen Bookstore and the College of Science Welfare Store are made on account.
10. The maximum purchase quantity for drugs is 50 g (except commonly used solvents, for example, 20 L Ethanol). If the required chemicals exceed 50 g, please ask the safety officer if they can be purchased.
11. After purchasing new chemicals, please contact the safety officer for registration. (cas no., drug name in Chinese and English, grams, brand, agent, and chemicals cabinet storage number)
12. Prioritize to think about how to repair the instrument by the whole laboratory. If there is no other way, go to the manufacturer for repair.
13. There is a monthly upper limit for the amount of consumables. If the amount exceeds the limit, the salary of master's students will be reduced proportionally.

Instructions for Reservation and Payment of Valuable

1. Account number of valuable instrument system

   Students can register on the valuable instrument system of the Ministry of Science and Technology. After registration, log in to the valuable instrument system. They must enter the project code on the research project's website and await approval. Before reserving the instrument, you need to fill out an online form.

2. Payment for valuable instruments

   After the experiment, you can check the payment deadline on the valuable instrument system. Remember to pay within the deadline. Otherwise, the plan will be locked, and you cannot reserve.

3. Payment process for valuable events on campus:

   Please go to the valuable instrument system to check the amount payable for the instrument and inform Angela of the fee and reservation number. Please, Angela, log in to the accounting system to print the original voucher slip. After the deposit slip has been stamped to the secondary supervisory unit authorized by the principal, give the deposit slip to the person in charge of the valuable instrument (Valuable Instrument Center in the basement of the International Studies Building). The instrument operator will be asked to write off the reservation record, and then the payment can be completed.

4. Please keep in mind:

   - The person in charge of valuable instruments may change. If you don't know who should pay for the original voucher slip, it is most accurate to ask the instrument operator.
   - The person responsible for the valuable instrument is not necessarily the same as the operator.
   - Wang Liangzhu (TEM) may have issues with bills being sent to teacher accounts, resulting in non-payment notices. When using it, the operator must be reminded of the bill flow or call in person to confirm.

5. Payment process for another schools:

   - Payment methods will be announced on each school's website. Students who have made reservations can check online or call to inquire.
   - You can reimburse or use petty cash. Finally, please take a photo of the remittance slip, along with the project leader, experimental equipment, reservation serial number, recipient's name, delivery address, unified business, and Heading, and send it to the email provided on the payment notice. Wait for the receipt back, and give the receipt to Jiahe for accounting.

6. On-campus Zeiss SEM payment method (if you don't understand, ask the operator)

   The operator gives a payment slip → Take it to Angela to open the original voucher slip → Take it to the Chemistry Department Office for stamping → Take it to the operator of the Materials and Optoelectronic Science Department Office.

7. On-campus 6330 SEM payment method

   The operator gives a payment slip →Take it to the student responsible for the instruments →The student in charge will log the payment slip online and hand it over to Angela for reimbursement

Business Trip Regulations:

1. Fill out the business trip application form in advance (the teacher and department office will approve it). There is no need to fill in the source of funds. The application date must be before the business trip.
2. Regulations for Subsidizing Students' Domestic and International Travel Expenses:
   (1) Before the trip, students must inform Angela of the travel destination and nature of the conference. Angela will advise on the scope of the subsidy. If you have any questions regarding the subsidy regulations, please discuss them with Angela first. Angela will consult with Prof. Chen to find a solution.
   (2) Domestic Conferences (held in Taiwan):

      i. Accommodation: NT$600 per night
      ii. Transportation: Reimbursed based on actual expenses
         a. PhD students and postdocs: High-Speed Rail (HSR) fares for both departure and return trips are subsidized
         b. Undergraduate and Master's students: Taiwan Railways (TRA) fares for both departure and return trips are subsidized
      iii. Registration Fee: Reimbursed based on actual expenses

   (3) International Conferences (held in Taiwan):
      i. Accommodation: NT$1,000 per night
      ii. Transportation: Reimbursed based on actual expenses
         a. PhD students and postdocs: HSR fares for both departure and return trips are subsidized
         b. Undergraduate and Master's students: TRA fares for both departure and return trips are subsidized
      iii. Registration Fee: Reimbursed based on actual expenses

   (4) IV. International Conferences (held abroad):

i. Accommodation: Reimbursed based on actual expenses with receipt(s) required (maximum limit can be confirmed with Angela)

ii. Airfare: Reimbursed based on actual expenses

iii. Registration Fee: Reimbursed based on actual expenses

(5) After each trip, a report must be submitted to Chia-Ho for compilation and review. The report shall include a brief summary, photos (e.g., with posters or conference boards), and key discussions during the presentation. The traveler need to upload to the lab website and Facebook. Travel reimbursement will be processed only after submission.

(6) Long-term exchange students must provide and upload monthly activity updates.

Note: Transportation ticket stubs should be kept, such as train tickets (stamped with proof of travel after exiting), High-Speed Rail tickets, boarding passes, and e-tickets.

Group Meeting Regulations:

1. Before the Seminar, final defense, and another course, you must report to other students at least thrice. Other members need to ask questions to help improve the report's content.
2. Those who take the final defense need to report the final defense content to the teacher and classmates at the group meeting a few weeks before the final defense.
3. Each student must report a literature and research review at least once each semester and once during the summer vacation (at least two literature and three research reviews annually).
4. For group meetings, the teacher appoints one person as the hoster. This person must control the meeting time, record who asks questions, and report laboratory public affairs to the teacher.

Guidelines for seminar Presentation:

Second-year master's students must complete the following three tasks before their seminar presentation:

1. Discuss the topic and motivation with the advisor (regardless of graduation).

2. Schedule the research review for the semester before the seminar.
3. Present to lab members before the formal seminar (must include a postdoctoral fellow).

Graduation requirements:

Students need to personally participate in the poster competition at formal seminars and serve as the primary presenter.

2026 Laboratory Instrument in Charge Person Checklist

Equipment	First person in charge	Second person in charge
RDE-CV	Yuwi	
AUTOLAB	Yun-Pei/ Gil	
XRD	Chang-hong	
CVD (+小台管狀)	Tigger	Chia-Wen
Spin coater	Yun-Pei	
Plasma(報廢)		
Photoreactor	Tigger	
UV-vis	Gil	
Furnace/Oven	Shu-Yu	
PH meter Optical microscopy 參考電極校正	Yuwi	
Centrifuge	Tigger	
High flexibility Stirrer	Gil	
Bath sonicator	Tigger	
HP sonicator	Tigger	
Air conditioner	Chang-hong	
High pressure sprayer	Chia-Wen	Hong-In
MASS	Yun-Pei	Mariel
Flow meter	Yun-Pei	
Sharker	Shu-Yu	
Freeze dry	Chia-Wen	Hong-In

Cooler (Vacuum systemandReflux)	Yuwi	
Raman	Mariel/Yun-Pei	Gil
Power supply	Yun-Pei/Gil	
3D printer	Tigger	

Note:
- The first person in charge is responsible for the instrument's maintenance, management, storage of accessories and files, training, operation, time allocation management, etc.
- The second person in charge must be familiar with the management of the instrument by the first person in charge and act/take over the rights and responsibilities when the first person in charge goes out or graduates.

Precautions for Centrifuge:

1. Pairs of centrifuge tubes in the centrifuge must be of equal weight and placed diagonally.
2. If the centrifuge has an external cover, the cover must be properly closed before turning on the power switch during centrifugation.
3. After centrifugation, you must wait until the centrifuge has wholly stopped rotating before opening the lid. Do not block or force it to stop with your hands.
4. If there is any abnormality, such as noise or vibration during the centrifugation process, the speed must be adjusted to zero immediately, and the power must be turned off.
5. During centrifugation, you must always pay attention to whether there are any abnormalities in the centrifuge.
6. Regular inspection and maintenance.

- Error Code 31 Troubleshooting and Operation Manuals

Source： It may be due to improper sample placement during operation or the centrifuge not being in a horizontal position, which may cause the program to activate the protective measures and stop the instrument.

1. Turn the power switch off and rotate the Rotor by hand against the clock one to two times to smooth the motor.
2. Immediately turn on the main power switch (within 3 seconds) and verify that the interface is working correctly.
   - If this is normal, please follow the instructions below to troubleshoot and test.
   - If not, the motherboard may be broken.
3. Then, the test will be carried out in the same way as the original procedure. (Definition: From placing the sample to the automatic opening of the hatch, it is one cycle.)
4. After you complete the test, confirm whether the operating interface and hatch are open and functioning normally.
   - If it is normal, you can continue the operation.

- If not, it can be determined that the motherboard is damaged.



Precautions for Cell Disruption Equipment:

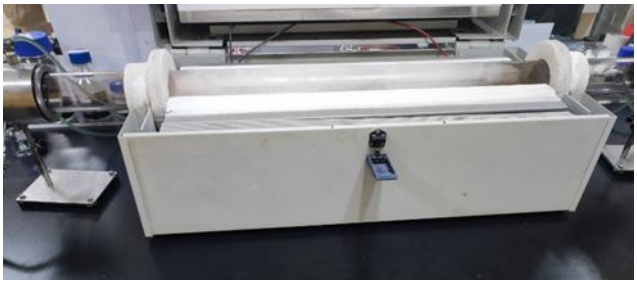
7. Do not let the probe directly rub against the bottom of the container, as it may damage the probe.
8. You can increase the amplitude When the solution is relatively viscous. However, if the power does not increase, no matter how you adjust the amplitude, do not adjust the amplitude any further.
9. When you finish the experiment, please wipe the probe to keep it clean
10. Please turn off the power after use.

Precautions for CHI614D/CHI704E:

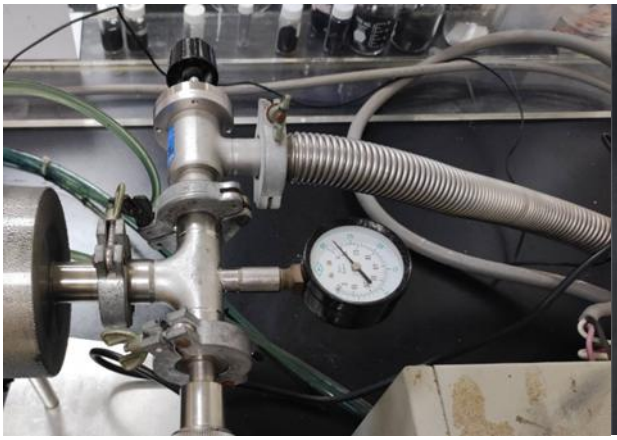
1. The Pt flake and the substrate need to be face-to-face
2. Stirring is required when measuring LSV.
3. You can use the parameters of the old file, but remember to click "Current Overflow". Otherwise, the instrument will burn out.
4. After each measurement, the reference electrode and Pt flake need to be cleaned with deionized water and dried with clean paper.
5. Never touch the crocodile clip to the electrolyte; otherwise, corrosion will cause data errors.

Precautions for CVD:

1. Nothing remarkably flammable (laboratory notebooks, paper) can be placed on the CVD workbench.



2. The internal pressure of CVD needs to be controlled at negative pressure. The pressure indicator is at the end of the CVD tube (right side), and the digital indicator is next to the heater controller (~5 10-3 Torr at vacuum condition).




3. The heater is in the correct position on the table, and it is not allowed to be turned on without any training, as the CVD can rise to 1400℃, and the tube will melt (>1200℃).
4. Every time the CVD starts burning, the pump and O-ring cooler need to be turned on as the gas is purged into the tube to prevent overheating of the O-ring and prevent positive pressure.



5. It needs to be controlled every 1-2 hours when used and cannot be burned overnight.



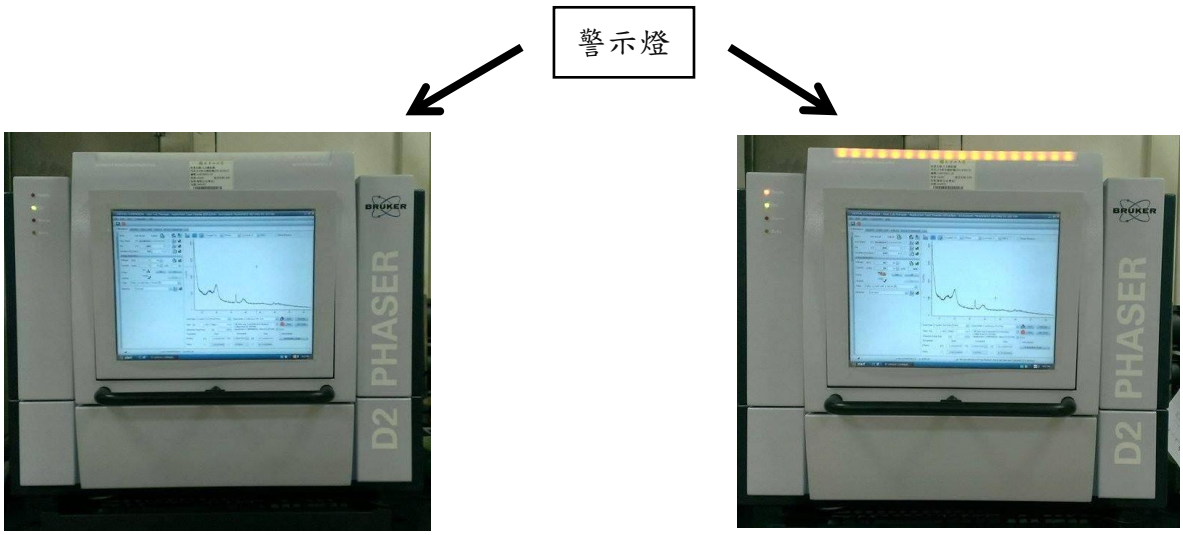
6. hydrogen can only use 5% of the total gas volume if using CVD.

Precautions for Oxygen Plasma:

1. close the pressure relief valve before turning on the pump for vacuuming to avoid damaging it and shortening its service life.
2. After 10 minutes of oxygenation, you must observe the color change when using the plasma. If the color turns purple (air has entered), you need to turn off the plasma and oxygen immediately and let the pump evacuate again to ensure no air in the environment.
3. After doing the plasma, you need to wait 5 minutes for the pump to absorb the ozone before turning it on.
4. Keep the instrument in a vacuum state immediately after taking out the sample

Precautions for XRD:

1. Graduate students can operate the instrument independently after receiving training from the instrument manager and operating it more than three times under the manager's supervision.
2. If undergrad students use the machine frequently, they will be considered for training and can operate it independently after being accompanied by the manager more than five times.
3. The sample plate is made of polymer, so be sure not to rinse it with acetone.
4. In the "X-ray Generator" interface→Press the "ON" button at the "X-ray." The upper warning light lights up, which means the X-ray lamp is on. **Please do not open the gate again to prevent X-ray leakage**. As shown below.



5. Please do not open the gate during the process to prevent X-ray leakage.
6. The instrument administrator always keeps software keys. Please register with the administrator before using the software.
7. If the weather is bad or there is a heavy thunderstorm, please try not to use the instrument to avoid damaging it; the timing of shutting down the computer also depends on the weather, such as typhoons, thunderstorms, etc.
8. After you finish the measurement, please save the data to the computer. You are strictly prohibited from accessing the Internet or plugging personal USB devices into the desktop computer.

Precautions for PH meter:

1. The glass electrode must be calibrated before use.
2. Clean the electrode every time you change the solution, and then only use DI water for cleaning.
3. Close the cap after use, and do not let the electrodes come into contact with air.

Precautions for Square Furnace:

1. Do not place flammable materials (paper, notebook) nearby.

2. Be careful not to get burned.

Precautions for Spin Coater:

1. Cover the lid when using to avoid splashing
2. After you finish coating, you must wait until the rotation speed reaches 0 before stopping.
3. After stopping, unplug the vacuum motor before taking out the sample.

Precautions for Photochemical Reactor:

1. UV rays can cause damage to your skin and eyes. Check the indicator light on the top when the UV light is open.
2. Even the UV light that is on can work. Always use protective equipment (gloves, UV protective mask) to prevent prolonged/exposure. Prolonged exposure may cause skin discoloration and eye damage.



Precautions for Mars:

1. Close the MAsoft software (if the experiment is in progress)
2. Close the RC interface
3. Turn off the capillary power unit
4. Turn off the vacuum control unit pump switch (Wait for the system to show zero)
5. Turn off the rocker switch on the primary socket (green switch behind the mass spectrometer)

Precautions for SEM:

1. Before turning on the filament, please ensure the diffusion pump has been warmed up for 30 minutes to avoid oil vapor from back-filling the vacuum chamber and causing contamination.
2. Make sure the workpiece is clean. When placing the workpiece, please wear gloves to avoid oil stains on your hands from contaminating the vacuum chamber.
3. The operating working height is the centrality reading of the height of the workpiece to prevent the workpiece from hitting the orifice and detector if it is too high.
4. Before rotating the workpiece upright, please follow the movement restrictions of the test piece stage to avoid hitting the orifice and detector.
5. If the scene flickers on and off during operation, please turn off the filament immediately and stop any operation. This is a sign of filament burnout.
6. Adjusting the electron gun's data during operation is strictly prohibited. This action will only be adjusted when replacing the filament.
7. please clean the glass cover after use for gold plating machines.
8. Turn off the filament, take out the workpiece, and confirm that the filament has cooled for 30 minutes

before opening the vacuum chamber to avoid the filament still at a high temperature that will immediately come into contact with the atmosphere, causing the filament to be broken.

9. After the operation is completed and the system is shut down, wait for 30 minutes of cooling before turning off the ice water machine to prevent the vacuum oil from remaining at a high temperature and the oil vapor from falling back into the vacuum chamber.
10. After finishing the operation, please confirm whether the workbench position is adjusted to the center X-23mm and Y-25mm before leaving.
11. After finishing the operation, please confirm that the environment is clean and that the operation registration has been filled out before leaving.
12. Be careful during the operation to protect the filament's life.

laboratory duties

1. Laboratory safety: safety training for new personnel, safety training lectures for laboratory personnel, environmental safety matters, toxicant declaration operations, laboratory waste disposal, and other matters →Yun-Pei, Mariel
2. Laboratory property: All property in the property book must be labeled, and matters such as property scrapping and property transfer must be handled→ Shu-Yu
3. Laboratory Finance: Assist in reconciling invoices and receipts from relevant suppliers with Angela and support other students in processing reimbursement. → Chia-Wen (Responsible for advance payments, postage, and payments for instruments), Shu-Yu (Responsible for all vendors)
4. Cleaning Team Leader: Arrange laboratory on-duty students and supervise the cleaning of two laboratories twice a year cleaning work→ Gil
5. Web page maintenance and computer data: website update every two weeks, maintain and manage all electronic information equipment, including laboratory file photo sorting → Company (Upload), Chang-hong (Contact Company)
6. Person in charge of valuable instruments: Mainly responsible for overall planning of SEM/TEM schedules and time reservations, summarizing and notifying financial payments, and regularly confirming whether there are any account lock issues →Chang-hong
7. Group meeting: Confirm the classroom rental situation, prepare and keep the projector pen, and open the door in advance. → Mariel
8. English corner → Kelly

If the personnel responsible for the above-mentioned duties or instruments need to be away from the laboratory for an extended period, please ensure that a secondary responsible person is designated in advance to maintain continuity in operations and instrument management and to prevent any disruption to experimental activities.

How to write an experiment record book

Experiment Title

(make the title understandable to know what the experiment is all about, i.e. GO preparation, CMO, PDs stability test, etc.)

Expt. Control Number
(i.e. CMO-25)

Date
(yyyy.mm.dd)

Main Chemical Reaction

(The chemical reaction that can represent the experiment.)

i.e. $CH_4(g)$ —CVD process (write in detail the parameters in the experiment here. The more detailed, the better)→ single-layer graphene

1 g graphite —Hummer's method→ graphene oxide

Mg^{2+} (2 M) + Al^{3+} (1 M) —100ºC, 24 h→ Mg-Al LDH

Procedure

(1) …
(2) …

As if you're repeating the experiment, write:

Same as CMO-2, or
Same as CMO-2, but hydrothermal process changed into 4 hours. Please refer to the detailed one.

Important Chemical Reagents

(i.e.)

$Mg(NO_3)_2 \cdot 6H_2O$	5 g
$Al(NO_3)_3 \cdot 9H_2O$	2.5 g

Real Case

(example 1)

$Mg(NO_3)_2 \cdot 6H_2O$	5.2003 g
$Al(NO_3)_3 \cdot 9H_2O$	2.406 g

(example 2)

I was writing the experiment, but there was not enough reagent. I need to do it, so the concentration is the same, yet the yield was only half of the original.

(example 3)

Because of… causing the delay of the reaction until April 1.

(example 4)

The experiment did not work because I failed to open the oxygen gas.

Product: 3.4567 g

Yield: 88.3%

Physical Properties:
black powder, very lightweight

next page →

Notes

Experimental Observations, Evaluation of Results, Product Transport, Remarks/Thoughts (examples)

1. When A was added, it formed a black precipitate

2. If the temperature increases after reflux, it will eventually decrease after 10 minutes

3. The product produced is less, doubling the concentration on the next experiment is desired.

4. The product was placed under SEM. The particle size is about 30 nm

5. Raman results suggest it is single-layered graphene.

6. This time, 10 mL GO was used to produced GO-CMO-13. The rest were brought to Professor X's Laboratory

Why do we need to write everything in a laboratory notebook?

1. It is going to be very easy for us to find the experiment.
2. All samples will have a control number to avoid confusion.
3. There will be convenience in finding the procedure we need.
4. If there are duplicate experiments with slight differences in the procedure and conditions, we can easily distinguish it.
5. The people in the lab, including the underclassmen, can easily read your lab notebook.
6. The quantity and concentration calculations should be written for future reference.
7. It can aid you in case you need to refresh your memory in the future.
8. You can compare various products you have made by providing data in case you need to do this in the future.
9. Our human memory cannot be that reliable. So, writing all our observations in the lab notebook should be written, including the whereabouts of the sample and what characterization techniques were done. This will avoid unnecessary replicate experiments which will waste some lab resources.

Laboratory Notebook Reminder:

To those doing hydrothermal synthesis, please have your own acid bath to avoid contamination.

Laboratory presentation example

Chen Lab NSYSU Chem

Your Topic

1. 含氮GO的水熱合成: 用urea調控pH
2. MB在可見光催化

Your Name

實驗紀錄簿編號

報告時間 (i.e. 7. 11. 2014)

From 7. 3. 2014 to 7. 10. 2014

Proprietary and Confidential

Chen Lab NSYSU Chem

Last discussion

- Discussed work from last meeting
- 之前討論，老師說要做的事

Proprietary and Confidential

Preparation (合成)

鑑定結果

重點說明

此實驗哪裡不同?
為何作這個實驗

Sample (Name)	Code (Lab notebook)	Method	Description	Characterization	Others
Cobalt manganese oxide (CMO)	CCM-35	hydrothermal	Low cobalt content (vs. CCM-36)	XRD, SEM, EDS	P. 35
CMO-100	CCM-36	hydrothermal	High cobalt content (vs. CCM-35) 再現性測試	XRD	P. 36 in your lab note
Nitrogen-doped G.O.	KGG-89	Hummers	我使用新的石墨粉 (vs KGG-87)	Not yet	好像失敗了，重作一次再比較 (KGG-90)
單層石墨烯	LGM-56	CVD	新的銅片，時間由原來 20min 縮短到 5min (vs LGM-20)	Raman, 光學顯微鏡相片 (好像是多層)	時間縮短破洞好像變多

鑑定結果列在後續投影片

Results of Samples

- Your Results Here

Description
What are we seeing?

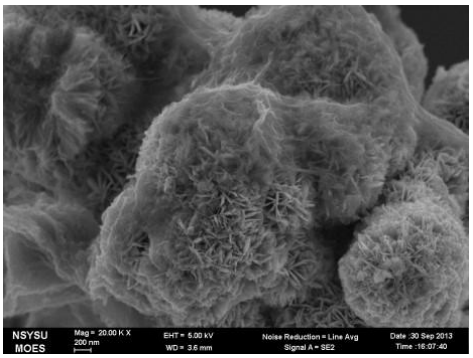
Description
Comparison?

Description
Where are these results?

Description
Where are these results?

Proprietary and Confidential

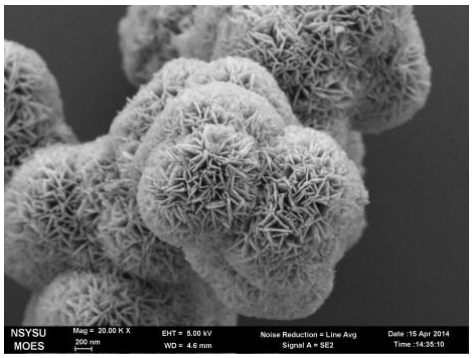
Results (SEM) of Samples (CMO-100)



Description
After GO hybridization

Description
Path: chc/結果/SEM/gcmo-20-2

Exp. Code
CCM-36



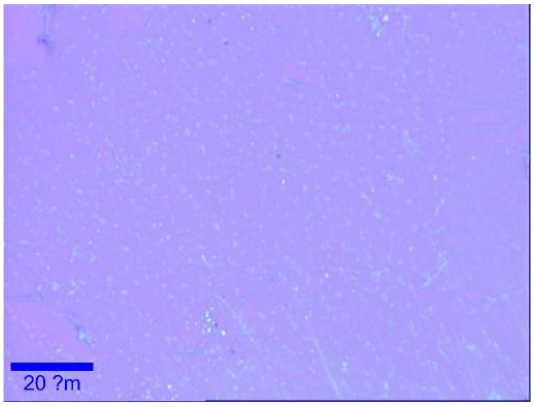
Description
Before GO hybridization

Description
Path: chc/結果/SEM/cmo-100C-12

Exp. Code
CCM-10

Proprietary and Confidential

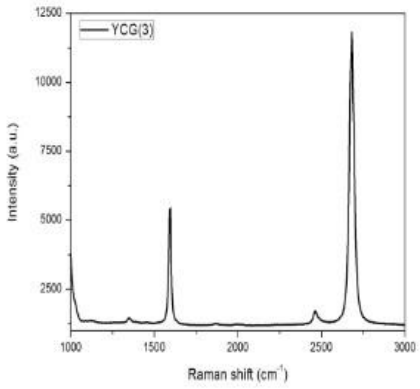
單層石墨烯 (新銅片) of YCG-3



光學顯微鏡圖 (OM of something; if more than one)
新銅片作的石墨烯
表面不乾淨有大量破洞

Patch: YCG/結果/Raman/OM-5

YCG-3



光學顯微鏡圖 (OM)
新銅片作的石墨烯
表面不乾淨有大量破洞

Path: YCG/結果/Raman/spec/YCG3-5

Proprietary and Confidential

Data Interpretation/Conclusion

- What is the meaning of your data?
- What is the critical message for your next move?
- What do we learn from your data?

Proprietary and Confidential

Next

- What are you going to do next?

Proprietary and Confidential

How to search for literature

1. Search for keywords on the Web of Science, the ACS website, and Google Scholar, and select the literature you want. **Do not use Google** as your only background literature search.

2. The preferred journal is **ACS > Nature springier = Science.** Do not choose Elsevier; the journal points must be at least 3.

3. Do not select paper written by Chinese or Indian authors.

Prof. Chun-Hu Chen's Laboratory Hazardous Event Record Form

事發人	湯宜諺		
事發時間	2022/9/21 15:30		
事發地點	離心機旁邊的實驗桌上		
事發內容	被玻璃劃傷		
事發原因及可能造成結果	手碰到量筒導致量筒掉至地板，想接量筒的瞬間卻被玻璃劃傷。 造成手部逢了一針，嚴重的話如果劃傷大動脈可能造成血流不止而亡。		
預防措施	不要不自量力的想要接掉落的玻璃物品 手比玻璃更珍貴! 玻璃物品也請不要放置到桌子邊緣，這樣一碰到就容易掉落。 如果玻璃物品掉落也請戴好棉布手套去清理，不要空手去清。		
事發圖片			
安全人員核准		核准人員確認	

事發人	陳君豪		
事發時間	2023/2/11 00:10		
事發地點	冰箱旁抽風櫃中的方形高溫爐		
事發內容	聽到爆炸聲及發現冒煙		
事發原因及可能造成結果	事發原因：草酸銀爆炸。 草酸銀受熱時，會分解產生銀及二氧化碳，反應式為：$Ag_2C_2O_4 \rightarrow 2Ag + 2CO_2$，當加熱溫度來到 140 度就會開始分解 [1]，若產生的二氧化碳無足夠時間釋放，則會累積並產生爆炸；且分解過程為放熱反應，加熱時間不夠長，容易使熱量累積也會發生爆炸可能。而此次爆炸原因應是量未控制好(放入大約 1.8 g)，及加熱時間未拉長，讓草酸銀無足夠的時間分解造成二氧化碳與熱量累積導致爆炸。 Ref 1. Zope, Khushbu R., Denis Cormier, and Scott A. Williams. *ACS Appl. Mater. Interface*. **2018**, *10*, 3830-3837		
預防措施	由於草酸銀的起始分解溫度約為 140 度，因此在 140~200 度的期間應把加熱時間拉長，原本的設定為：由室溫升至 200 度 2 小時，在 200 度下持溫 2 小時，**應改成由室溫升至 130 度 1 小時，在 130 度下持溫 1 小時，再從 130 度升到 200 度 3 小時，200 度下持溫 1 小時**，讓草酸銀有足夠時間釋放熱量。**每次放進烤箱的量不得超過 500 mg**。而實驗過程也**必須在抽風櫃中進行。若實驗為初次嘗試，必須確認安全無虞才能在半夜進行。**		
事發圖片			
安全人員核准		核准人員確認	

Prof. Chun-Hu Chen Laboratory Accident Report F

陳軍互教授實驗室危險事件紀錄表

Person(s) Involved 事發人	Yanita Devi, 許婉筠
Time of Accident 事發時間	2021.08.03 16:00
Area of Accident 事發地點	In the CVD place CVD
Description of Accident 事件內容	The CVD temperature increase up to ~1400°C and make the glass tube melt and the tube cannot be further used. CVD 溫度升至 1400 度，讓石英管軟化變形，無法再使用。
Probable Cause of Accident and Consequence of this Accident 事發原因跟事發後果	The heater has the problem which is the temperature in the CVD chamber will keep increase even the heater is off. The difference between the heater and tube temperature to big (~400°C). Lack of notice to the CVD temperature so nobody knows that the temperature was went beyond the setting temperature. 加熱器的問題，當停止加熱時，溫度還是持續上升，且管內溫度和顯示器的溫度不同。當下沒有特別注意溫度，導致沒有人留意到溫度已經超過設定值。 Can cause explosion, may cause fire and will burn the nearest things. Will cause a serious injured to the people. 會導致爆炸，燃燒使附近的物品起火，並且讓實驗室成員有危險。
Preventive Measures (Short-term)	Immediately turn off the heater, keep turn on the vacuum pump and turn off any explosive gas. Do not use until it fixed. Prepare the fire extinguisher near the CVD. Need a short

短期預防措施	briefing before used. Need to understand what gas will be used and how to prevent accident. 立即關閉加熱開關，保持真空環境，直到修理好為止不能使用，旁邊需準備滅火器。使用前須講解介紹，了解需用什麼氣體及如何預防。		
Preventive Measures (Long Term) 長期改善措施	Need to pay attention to the increase of the temperature (control every 1-2 hour). A serious study and knowledge should be told to the lab members. Never used without any person observation. Cannot be used overnight. 每一至兩小時，需要隨時注意上升時的溫度。實驗室成員都須了解使用規則，不能在沒人時使用，也不能用過夜。		
Photo of the accident 事發圖片			
Safety Officer Approval 安全人員核准		Laboratory Head Approval 核准人員確認	

事發人	陳冠廷
事發時間	2023.07.19 16:16
事發地點	藥櫃前 In front of the chemicals storage cabinet.
事發內容	裝n-Hexane的玻璃藥罐破掉，導致液體流出 The glass container containing n-Hexane was broken, causing fluid to flow out.
事發原因及可能造成結果	取完溶液後要放回藥櫃，開門前放在藥櫃前地上，未注意藥品與門距離，開藥櫃門時門角撞到藥品，藥品倒地破掉流出。 腳只被濺出的Hexane潑到，潑濺到的部位也並未被玻璃碎片劃傷。 嚴重的話，不只導致玻璃碎片劃傷腳部，若是腐蝕性液體將造成嚴重傷害!! After taking the n-Hexane, and putting the container on the ground in front of the chemicals storage cabinet before opening the door, I didn't pay attention to the distance between the chemical and the door. When opening the door, the door corner hit the container resulting in falling to the ground and breaking and flowing out. The feet were only splashed by the spilled Hexane, and the glass shards didn't scratch the feet. In severe cases, not only glass shards hurt the foot, but corrosive liquids can cause serious injury.
預防措施	藥品入櫃前，先打開藥櫃門，才將藥品從操作處(ex: hood)放回藥櫃，不可放門前，防止撞到。 Before putting the chemicals into the chemicals storage cabinet, open the chemicals storage cabinet door before placing the chemicals back in the chemicals storage cabinet from the operation (ex: hood), not in front of the door to prevent bumping.

事發圖片			
安全人員核准		核准人員確認	

事發人	林璟翔
事發時間	2023. 08. 23
事發地點	洗手台下方的酸液桶。 Near the acid bucket under the sink.
事發內容	酸液桶內之溶液噴濺於洗手台下方並且滴落的酸液揮發於實驗室中。 The solution in the acid bucket splashed under the sink and the dripping acid evaporated in the laboratory.
事發原因及可能造成的結果	1. 拿取實驗器材時可能未瀝乾，因此容易造成酸液的溢出。 experimental equipment may not be drained when taking it, so it is easy to cause acid spillage. 2. 當拿取或放置器材造成容易濺出，未立刻使用濕抹布擦拭乾淨，導致酸液揮發瀰漫實驗室內 When the equipment is taken or placed and it is easy to splash, if it is not wiped off immediately with a wet cloth, the acid will evaporate and diffuse in the laboratory 3. 用於盛裝酸液的容器未採用密封式，會造成容器內的酸霧洩漏出來或洗手台迅速腐蝕，造成危害人體的疑慮。 The container used to hold the acid is not sealed, which will cause the acid mist in the container to leak out or the sink to corrode rapidly, causing doubts about harming the human body.
預防措施	(1)當有任何酸液滴落應立即用濕抹布清理乾淨。 When any acid drips, it should be cleaned up immediately with a damp cloth (2)拿取實驗器材時必須小心將器材內部殘餘溶液或壁上液體瀝乾或抖掉，再拿出酸液桶外。如果不甚滴出也應該立刻擦拭乾淨。 When taking out the experimental equipment, you must carefully drain or shake off the residual solution inside the equipment or the liquid on the wall, and then take it out of the acid tank. If there is no dripping, it should be wiped clean immediately. (3)拿取放置在酸液桶的實驗器材時，應戴上口罩避免吸入揮發的酸霧。 When taking the experimental equipment placed in the acid tank, wear a mask to avoid inhaling the volatile acid mist. (4)使用密封式的器皿盛裝酸液。 Use sealed containers to contain acid.

事發人	趙品晴
事發時間	2024/07/04 11:49
事發地點	洗手槽前面 In front of sink
事發內容	打破燒杯 break a beaker
事發原因及可能造成結果	當天在洗東西時，手肘不小心裝到放在洗手槽邊的燒杯，掉到地上並碎裂。如果沒有注意很可能被燒杯的碎玻璃刮傷。 When I was washing things that day, I accidentally knocked over the beaker placed by the sink with my elbow, and it fell to the ground and broke. If I wasn't careful, I might get scratched by the glass.
預防措施	易碎物品應小心放置，不應放在容易受到碰撞的地方，並且多人在一起行動時動作要更加小心。 Fragile items should be placed carefully and should not be placed where they are susceptible to collision, and movements should be even more careful when multiple people are moving together.
事發圖片	
安全人員核准		核准人員確認	

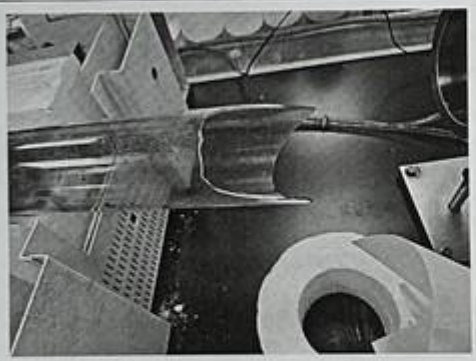
林暐翔

9/15 王映婷 Monica Nelson 陳姝妤 何敏瑋 陳靜為 陳羿廷 林慧珍 黃俊銘 李明俊 鄭凱琳 林芷之 李姵瑾 吳書豪

Prof. Chun-Hu Chen Laboratory Accident Report Form

陳軍互教授實驗室危險事件紀錄表

Person(s) Involved 事發人	Yanita Devi, 吳書豪
Time of Accident 事發時間	2021.08.14 14:10
Area of Accident 事發地點	In the CVD place
Description of Accident 事件內容	1. During the cleaning of the glass tube, the glass tube crack and bump into the table and broken at the edge. 2. No one gets hurt during the accident as goggles and gloves is used. 1. 在清洗 CVD 玻璃管的時候，因為在移動途中碰撞到桌子導致玻璃管邊緣碎裂。 2. 在這起事故中，因為大家都佩戴了護目鏡和手套所以沒有人受傷。
Probable Cause of Accident 事發原因	When 2 people holding the end of the tube, one of the edge of the tube is slip and bump the table make the glass tube crack and broken at the edge. 當 2 個人在移動並握住玻璃管的兩側時，其中一邊撞到桌子，導致玻璃管的邊緣破碎。
Preventive Measures (Short-term) 短期預防措施	1. During the taking out the tube need to make sure that both edge is being held well and without any obstacle or things nearby. 2. Before moving the glass tube, place a cloth or Styrofoam underneath to prevent it from directly touching the table. 1. 在移動、取出玻璃管時，應該確保玻璃管有被牢牢抓住，並且附近沒有其他障礙物。 2. 在移動前先放置毛巾或保麗龍，避免玻璃管直接碰觸到桌子。
Preventive Measures (Long Term) 長期改善措施	1. Need to pay attention on the nearby and things near by the tube. When take out and put in the tube need to put away any sharp or hard objects so it will not bump with the tube. 2. The gloves and goggles need to be used during the cleaning or any CVD glass tube related action. 3. During the cleaning or any CVD glass tube related cation, need to wear thick gloves to avoid getting cut by

	glass. 1. 需要注意玻璃管附近的環境和任何物品，在取出和移動玻璃管時，需要將附近的環境和物品淨空，避免任何碰撞。 2. 在清潔或進行任何與 CVD 玻璃管相關的操作時，必須使用手套和護目鏡。 3. 在清潔或進行任何與 CVD 玻璃管相關的操作時，需要戴上厚手套避免被玻璃劃傷。  **thick gloves**
Consequence of this Accident 事發後果	Sharp objects from the glass might scattered and might have some physical scratch and bleeding. 玻璃碎片可能會飛散，並可能導致劃傷或其他傷害。
Photo of the accident 事發圖片	
Safety Officer Approval 安全人員核准	劉昭明
Laboratory Head Approval 核准人員確認	

林曜翔 黃弘翰 陳翌廷 李姍曄 吳書豪
王映婷 郭冠宏 何敬淳 顏芷宜
趙品晴 陳靜瀅 陳姝妤 陳志豪

陳軍互教授實驗室危險事件紀錄

事發人	Chen, Shu-Yu 陳姝好 陳姝好
事發時間	September,19,2024
事發地點	The countertop next to the sink in lab 5008 in the Chemistry Building 化學館 5008 實驗室水槽旁邊的檯面
事發內容	Breaking a beaker results in a cut on the hand from a glass shard. 打破燒杯導致手被玻璃碎片割傷
事發原因及可能造成結果	While cleaning a beaker, the beaker slipped and broke when the cleaned beaker was placed on the countertop next to the sink, cutting the hand with a glass shard.清洗燒杯時，因將清洗好的燒杯放在水槽旁邊的檯面，造成燒杯滑落破裂，玻璃碎片割傷手。
預防措施	When cleaning glassware, place it in a box near the sink and put a rag inside the box to prevent it from breaking on impact. Then, take the cleaned glassware out of the box to prevent it from slipping and breaking again.清潔任何玻璃器皿時，應將玻璃器皿放在水槽內部較高的盒子中，並在盒子內放一塊抹布，以防止玻璃器皿在撞擊時破碎。再將清潔過後的玻璃器皿連同盒子一起拿出來，以防止玻璃器皿滑落而再次摔碎。
事發圖片	
安全人員核准		核准人員確認	

吳書豪 陳志豪 陳姝好 李姵瑾 趙品晴 林慧玲 何敬謹 陳群廷 黃凱翰 陳靜喜 All.

事發人	陳冠廷、吳書豪
事發時間	2024.11.01
事發地點	冷凍乾燥機下方幫浦 The pump under the freeze dryer.
事發內容	幫浦空轉造成馬達燒掉 The pump idling causes the motor to burn out
事發原因及可能造成結果	在8月底時，冷凍乾燥機在預冷過程中，發現幫浦有冒煙的情況，且發現棚板有結霜的情況，廠商當初認為可能是幫浦油的問題，因此將幫浦直接帶回，回去檢測完的結果是沒問題，推測可能是油加太多，因此當初廠商幫忙減少幫浦油後便將幫浦寄回，在收到幫浦後，我們就直接將幫浦那端插頭與連接冷凍乾燥機的管子接回。直到11/1，颱風過後復電，直接便將幫浦的插頭接到hood上的110V插座，發現幫浦很熱且無法啟動。 經過廠商查看所有線路，結果是幫浦的插頭並未插到冷凍乾燥機後方220V插座，直接就將插頭插到hood的110V插座上，造成電壓不夠驅動馬達運轉，使馬達持續空轉，最終導致馬達過熱並且燒掉。 這起事故的根本原因是因為我們不了解幫浦使用的電壓為220V且需將插頭插在冷凍乾燥機上，才能被冷凍乾燥機控制，直接便將插頭插到110V上，造成幫浦空轉，最終燒掉。 嚴重的話，不僅馬達燒掉，由於周圍可能有易燃物存在，可能會引發火災! At the end of August, during the pre-cooling process of the freeze dryer, we noticed that the pump was emitting smoke and that there was frost forming on the shelves. The supplier initially suspected it was an issue with the pump oil, so they took the pump back for testing. The test results showed no issues, and they speculated that too much oil might have been added. The supplier reduced the pump oil amount and returned the pump to us. Upon receiving it, we directly reconnected the pump plug and the pipe to the freeze dryer. On November 1, after power was restored following a typhoon, we plugged the pump into the 110V socket on the hood, noticing that the pump was very hot and unable to start.

	After inspection, the supplier found that the pump plug had not been connected to the 220V socket at the back of the freeze dryer but had instead been connected to the 110V socket on the hood. This resulted in insufficient voltage to drive the motor, causing it to idle continuously, eventually overheating and burning out the motor. The root cause of this incident was our lack of understanding that the pump requires 220V and needs to be plugged into the freeze dryer to be controlled by it. Instead, we directly plugged it into a 110V outlet, which caused the pump to idle and ultimately burn out . In severe cases, not only could the motor burn out, but if flammable materials were present nearby, it could potentially cause a fire!
預防措施	1. 幫浦周圍設立警告標語，提醒大家電線的使用。 2. 明確標示幫浦的使用電壓在電線上及周圍。 3. 交接儀器或是新生教學時，特別提醒電線的使用。 4. 不管任何目的，若有任何問題(ex. 聲音很大、冒煙、溫度很高)或是要拔下或插上插頭，以及使用幫浦和冷凍乾燥機，皆需要找負責人協助或監督。 5. 每次使用冷凍乾燥機前檢查電線及線路是否接得正確，且幫浦和冷凍乾燥機皆能正常運作。 6. 若是幫浦發生問題，需要馬上關機，禁止讓幫浦繼續運轉。 7. 每次使用冷凍乾燥機時，需填寫使用表單 1. Set up warning signs around the pump to remind everyone about the proper use of the electrical cord. 2. Clearly label the required operating voltage of the pump on the cord and in the surrounding area and label the plug place. 3. Emphasize proper cord usage during equipment handover or new user training. 4. For any purpose, any problem/concern about (loud sound, smoke, heating) plugging or unplugging the pump or how to use it with the freeze dryer, seek assistance or supervision from the person in charge.

	5. Before each use of the freeze dryer, check that the cords and wiring are correctly connected, and that both the pump and freeze dryer are functioning properly. 6. If any issues arise with the pump, immediately power it off and do not allow it to continue operating. 7. Each time the freeze dryer is used, a usage form must be completed.
事發圖片	

安全人員核准	劉明佩 2024 11.8.	核准人員確認	

黃冠宏 Meka Patcha Maniel G. Tecson

劉彥廷、李佩蓮 蔡宇文 DucAnhNgo

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Reading certificate for experimental operators

Experiment Operator	Record Date	Experiment Operator	Record Date