NUS National University of Singapore	**Department of Physics National University of Singapore**	**Ref. No**	*SOP/001*
Standard Operation Procedure **Title: Thermal Evaporator**		**Rev. No**	*004*
		Pages:	*4*
Lab: Nanomaterials & Devices Group			

Written by	Approved by	Issue date	Review date
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1. Purpose

The objective of this SOP is to provide guidelines to all the laboratory personnel on operating the thermal evaporator.

2. Scope

The procedure is applicable to all research staff, research students and technical staff working in the laboratory.

3. Responsibility

It is the responsibility of the PI in conjunction with the laboratory I/C to ensure that all research and technical staff and students are advised, prepared and trained.

3.1. Principal Investigator

The Principal investigator is responsible for the implementation of these guidelines and takes ownership of all research and technical staff, graduate and undergraduate students under his charge in ensuring that they will carry out their activities in a reasonably practicable manner. The PI has to ensure that all the above mentioned personnel are adequately advised, prepared and trained.

3.2. Staff / Students

All research and technical staff and graduate students are under the obligation to work and behave safely and are responsible for taking care of their own health and safety and not placing themselves or others at risk of injury

4. Personal protective equipment

Wear nitrile gloves when working with the glove box.

5. Safety precautions

Inspect equipment to be used and ensure all are in proper working condition. Report any equipment deficiencies prior to use.

6. Procedure

6.1. Pre-deposition

- Turn off pump first by pressing the [Start/Stop] button.
- Allow chamber to reach atmospheric pressure. This will take around 15-20 minutes. **Note: do not let chamber sit at atmospheric pressure for more than an hour or so as this will cause difficulty in lifting the lid. When this happens, evacuate the chamber to slightly below atmospheric temperature and turn off the pump. Allow chamber to reach atmospheric pressure again.**

6.1.1 Preparing the sample

- Place sample onto deposition stage and secure it with Kapton tape.
- Transfer the stage into the glove box around the chamber area. Consult SOP for the glove box if you are unfamiliar with the glove box's operation.
- Lift the lid up via the protruded lips of the chamber. Note: the lid is heavy; handle it with care.
- Open the shutter manually to reveal the catch at the center of the lid.
- Attach stage onto the catch. To secure stage onto the catch, match the grooves of the stage with the catch and slide it into the catch before locking it in place i.e. push it away from you before turning it clockwise. **Check that the stage is secured by pulling it towards you – it should not be able to detach from the catch.**

6.1.2 Replenishing deposition metal

- Inspect the source boats to determine if they need to be replenished. This depends on the deposition thickness you wish to achieve.
- Replenish the boat with source metal if needed. As a rule of thumb, a single gold pellet can last for two 50nm deposition sessions. Depending on the metal to be replenished, access to the glove box chamber vault may be necessary. If so, consult the SOP for the glove box.

- Close the lid and shutter. The shutter can be closed via the switch above the deposition control panel.
- Evacuate the chamber by pressing the [Start/Stop] button. Allow the pressure to reach around 10^{-7} Torr. This takes around 1-2 hours.

6.1.3. Setting the deposition program

- In the INFICON control panel, choose the desired deposition program from the the list of presets under the [X] menu.
- Navigate to [xxx] and select [Quick Edit].
- Edit the thickness and deposition rate for the target source metal. Note: the target source metal is stated at the top left corner of the monitor.

6.2. Deposition

- Press [Start] to begin deposition.
- Ramp up the power supplied to the source boat by turning the knob. Increase the power to achieve desired deposition rate. **Note: there is a delay between applied power and deposition rate. Adjust power slowly when reaching desired deposition rate to avoid overshooting.**

- Allow deposition rate to stabilize, then open the shutter.
- Observe deposited thickness and deposition rate throughout the deposition process. Adjust power accordingly with the knob to keep within desired deposition rate.
- Close the shutter when desired thickness is achieved. Power will ramp down automatically if thickness is set correctly.
- If 2-step deposition program is used, press [Next] to switch to second source metal. Repeat the above deposition procedure. Else, allow source to cool for 15 minutes.

6.3. Post-deposition

- Evacuate the chamber by pressing the [Start/Stop] button. Allow the pressure to reach around 10^{-7} Torr. This takes around 1-2 hours.
- Turn off the pump and allow chamber to reach atmospheric pressure - this takes around 15-20 minutes.
- Open the shutter and open the lid.
- Unload the deposition stage, close the shutter manually, and then the lid.
- Retrieve deposition stage from glove box.

7. Revision History

Date Revised	Revision No.	Author	Revision Summary
	001		
08.10.2018	003	Ng Hong Kuan	
19.12.2021	004	Justin Zhou Yong	Adopted standard format. Revised SOP to include more details.