

**UiB NanoStructures Laboratory**  
**Standard Operating Procedure**

# **Raith e-Line Electron-beam Lithography Tool**

**Purpose of the instrument:**

The Raith e-Line can be used to expose a resist thin-film with flexible computer-generated patterns. The pattern in the resist layer can then be transferred to a different thin-film using a variety of processes also available at the UiB NanoStructures Lab (e.g. reactive-ion etching, lift-off, wet-etch, etc.). Maximum resolution is about 20nm half-pitch using PMMA as resist. Accuracy of interferometric stage to position sample is 1.5nm.

**Location of the instrument:**

Allégaten 55, room 276

**Primary Staff Contacts:**

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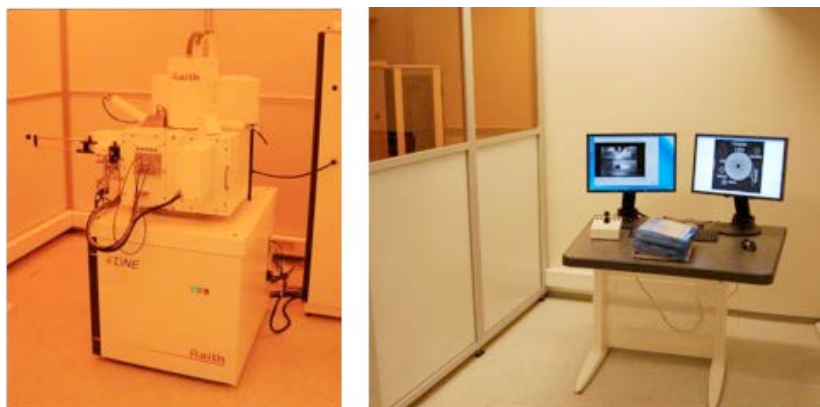
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Application Scientist: Nikolas Damnik, (Tel: +49 231 95004-208, E-mail: [damnik@raith.de](mailto:damnik@raith.de))



**Figure 1: Raith e-line and operating system.**

**WARNINGS**

The system produces X-rays, if the high-voltage is turned on. Do not remove any covers during operation! The system uses lethal high voltages up to 30 kV. Touching the power supply may result in death or serious injury. Do not change any system connections (especially the grounding!) Needless to say: Servicing of the column or high voltage system is restricted to Raith service engineers!

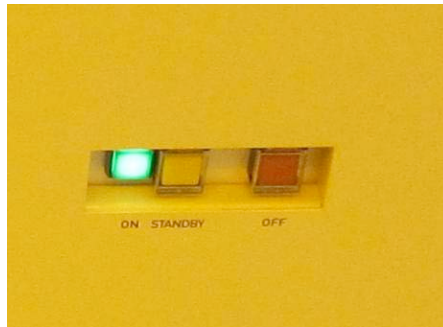
*The UiB NanoStructures Lab is operated for the benefit of all researchers. YOU MUST HAVE RECEIVED PERSONAL TRAINING ON THE INSTRUMENT TO BE PERMITTED TO OPERATE IT! IF YOU HAVE BEEN TRAINED AND ARE STILL UNCERTAIN AS TO HOW TO OPERATE THE INSTRUMENT CONTACT ONE OF THE STAFF MEMBERS. If you encounter any problems with this piece of equipment, please contact the staff member listed above immediately. There is never a penalty for asking questions. If the equipment is not behaving exactly the way it should, contact a staff member. This SOP only serves as a quick reference. For further details consult the manual and/or service engineers.*

## **Maintenance Procedures**

These procedures should only be carried out by the trained primary staff contacts!

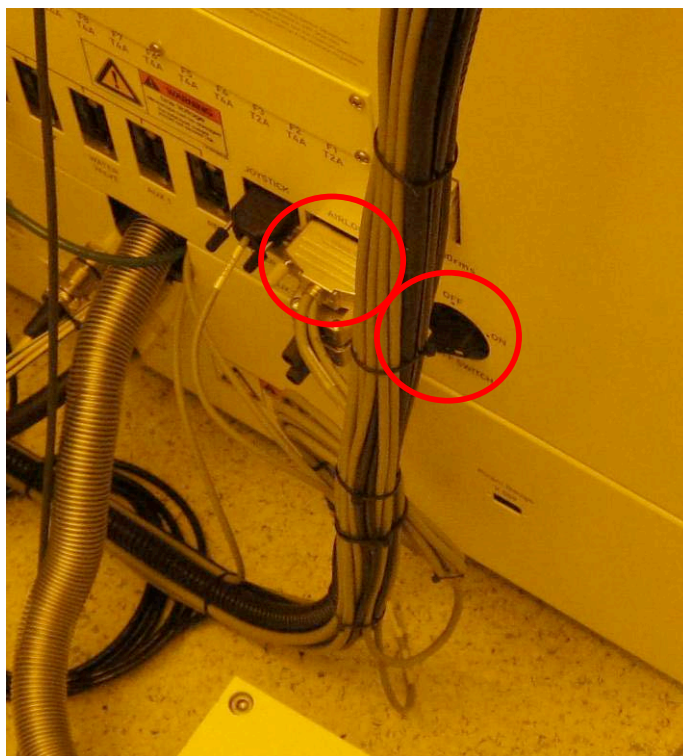
### **Turn e-Line off**

1. Log on as 'Administrator' in SmartSEM software (use the file menu to log out first if it is running already).  
Password: NanoRaith2011
2. Make sure the EHT is off (Red cross at EHT button at the lower right of the software).
3. Click on the 'Gun' button at the lower right of the software. Select 'Shutdown Gun'. Wait for the process to finish.
4. Log off from the SmartSEM software.
5. Shutdown the EM server software (It might be minimized to the lower right of the Windows XP taskbar) by clicking the x button.
6. Shutdown Windows XP (which also turns of the computer). Wait for computer to switch off, observing its LED lights in the electronics rack.
7. Push the Yellow 'Standby' button on the e-Line itself, removing the plastic cover first. (see Figure 2)



**Figure 2: On, stand-by, and off button on e-Line.**

8. Remove the 'Airlock' d-sub plug at the back of the tool. This will prevent the tool from venting completely.



**Figure 3: Airlock d-sub plug and power turn-switch.**

9. Push the red power button, next to the stand-by button, removing the plastic cover first.
10. If there is going to be an expected power cut, also switch off the black turn-switch at the back of the tool.

### **Turn e-Line on**

1. Make sure the water-chiller is running.
2. Plug in Airlock d-sub plug (see Figure 3).
3. Turn the power turn-switch (Figure 3) to the on position.
4. Push the yellow Standby button at the front of the tool (see Figure 2). Wait at least 1 minute.
5. Push the green ON button at the front of the tool (see Figure 2).
6. After the computer has started up, log in Windows XP using the Standard account.
7. Check that all the electronics in the rack is switched on (Beam blank controller, High speed pattern generator, Piezo controller, Airlock control, Precision stage controller, Laser Interferometer Source. If necessary switch on the Keithley Pico Amperemeter.
8. Double click on the Raith EO icon on the desktop to start the EM Server.
9. Make sure that all EM server messages have a green indicator during start up - else contact service team.
10. Log into SmartSEM software using Administrator account.
11. Wait until the vacuum has recovered, so check that in the vacuum tab 'EHT Vac ready=Yes' is indicated.
12. Start up the electron gun by clicking on the Gun button at the lower right of the SmartSEM software, and selecting 'Gun on'.
13. After the Gun has run up, log off 'administrator' and log on as 'qtest'.
14. It may take up to 10 minutes before the laser interferometer can lock the position of the stage successfully.

### Refill cooling water in chiller

Once a month the water level in the chiller (Storage room) should be checked, by opening the lid on its top. The water level should be close to the lower edge of the inside of the inlet. If necessary fill it up with de-ionized water.

### Cleaning of laser-interferometer fiber

Due to the optical tweezer effect a lot of contamination can built up at the end of the optical fibre of the laser-interferometer. For this reason it needs to be cleaned every few months. Once it has become too dirty to operate, the locking mechanism of the interferometric stage will begin to turn on and off erratically. See Chapter 5.6 in the e-Line System Operation Manual for details on how to clean the fibre (this is straight forward) and or measure the signal voltage from the interferometer - can be done with the oscilloscope available from the Magic Lab.

Check chapter 5 in the e-Line System Operation Manual for further information on Maintenance of the system.

### Facilities overview:

Here is a list of the facilities required by the system (can be also found in the manual) and some notes on how they are implemented here at UiB:

1. **Cooling water:** The e-line has its own chiller, which is located in the storage room.
2. **Compressed air:** This is supplied via the house compressed air, which is typically at 7 bar. There is an oil filter in room 268 above and to the left of the emergency exit door. It is used to keep the column chamber valve open. If that closes while the EHT is on, it may cause significant damage to the column. For this reason we already have a stand-alone compressor.
3. **Nitrogen 5.0:** Used to vent load-lock and main chamber. It is generated from the compressed air using a nitrogen generator that is located in the Fyrom of the physics building. So if the compressed air goes offline also expect the nitrogen to stop flowing. This is supplied to three different parts of the tool:

## **Document History**

Version 0.1, 27 FEB-2012, Author: Thomas Reisinger, Changes: Created

Version 0.2, Sept-2014, Author: Melanie Ostermann, Changes: Update primary stuff contacts, insert cross-references to figures, page numbers.