# Checklist for NPGS Training

When the Installation & Training is provided with NPGS, items marked with (◄►) must be available, while the other items are optional or are just listed for reference.

**If any of the marked items will not be available, the situation must be discussed before the on-site visit**. Also, if it was supplied with NPGS, the PC should be turned on before the on-site visit is scheduled to check for any damage during shipment.

**If you have any questions about any of the items listed below, please write or call before the NPGS training.** *(*Ignoring the preparation details listed below may waste valuable time during the NPGS training and even reduce the effectiveness of the training!**)**

## Equipment needed after the sample is exposed:

***PMMA coated Si samples will be provided during the training.***

| | |
|---|---|
| ☐ ◄Developer*****, 3:1 IPA:MIBK► | - 3 parts isopropyl alcohol to 1 part methyl isobutyl ketone, or more precisely: 3 parts (2 propanol) to 1 part (2-pentanone,4-methyl). The developer should be mixed under a hood **before** the NPGS training. Typically, 30 to 50 ml will be used during the training, but more can be mixed and used for months.<br>- ***Important**: When using premixed developer (often from MicroChem), be sure to check the expiration date, since old developer will often degrade the results. |
| ☐ ◄Fume Hood► | - For sample development. |
| ☐ ◄2 Beakers► | - Typically 50 ml to 100 ml. The beakers should be cleaned **before** the NPGS training. |
| ☐ ◄Compressed $N_2$► | - To blow off the sample. Alternately, almost any compressed gas can be used. |
| ☐ Optical microscope | - Used to inspect the sample after development. ***While an optical scope isn't absolutely required, it is highly recommended***. Typically, the best quality optical scope that can conveniently be accessed will be used. |
| ☐ ◄Sputtering System► | - The sample must be coated before viewing in the SEM, however, an evaporation system may be used instead. Metals with a small grain size such as AuPd, Ti, or Cr, are highly recommended, but other metals such as Au can be used, if necessary. ***The facilities for coating the sample should be evaluated before the training visit to ensure that they will be readily available on the third day of the training and can reliably produce a film with a thickness of ~2 to 10 nm.*** |
| ☐ Evaporator | - If a sputtering system is not available, an evaporator can be used. |

## Accessories for the SEM:

***The user should have a good working knowledge of the operation of the SEM.***

| | |
|---|---|
| ☐ ◄XY Input► | - Access must be available to the XY inputs. |

 

# Checklist for NPGS Training

| | |
|---|---|
| ☐ ◄Picoammeter► | - The Keithley 6485 is commonly used. Apertures for making Faraday cups are included with NPGS. Also, a sample holder with a Faraday cup and gold resolution standard will be provided during the training. |
| ☐ ◄Specimen Current Connection► | - The picoammeter must be attached to the specimen current connection on the microscope. Often, the specimen current connection will require an adapter for use with a BNC cable. ***For consistent lithography results, it is essential to be able to accurately measure the beam current that is hitting the sample.*** |
| ☐ ◄Image Signal Output► | - This is normally a standard feature of most microscopes. It provides a voltage signal that is proportional to the secondary image intensity and is used by NPGS for the system calibration and for the manual and auto-alignment modes. A BNC connection is required and the voltage must be within ±10 volts. |
| ☐ Beam Blanker | - A beam blanker is not required for lithography, but having one is generally recommended. If used, the blanker must accept a digital on/off input signal within ±5 volts on a BNC input. |
| ☐ Automated Stage | - If an automated stage is to be used with NPGS, the stage must have a communication interface (typically RS232 or Ethernet) and a software driver must be available for NPGS to communicate with the stage. Drivers for most common stages are available at no charge. |
| ☐ Digital Interface | - If the digital interface of the SEM is to be used with NPGS, the SEM must have a communication interface (typically RS232 or Ethernet) and a software driver must be available for NPGS to communicate with the interface. Drivers for most common SEM interfaces are available at no charge. |
| ☐ Scan Rotation | - This allows the writing (scanning) axes to be rotated about the center of the field of view. This is a very useful option to have for lithography. |
| ☐ Table for NPGS PC | - The NPGS PC should be located within ~1m of the inputs to the SEM. Often the CPU will be placed on the floor and the monitor on a table next to the SEM console. **Depending on the room arrangement, extension cables for the monitor, keyboard, and mouse may be required**. |

**Equipment for testing the SEM:**

| | |
|---|---|
| ☐ Oscilloscope | - A two channel oscilloscope *may* be needed during the installation to check the performance of the beam blanker and/or the output voltage of the SEM image signal. *In most cases, this is not required.* |

 

# Checklist for NPGS Training

**Items normally used for SEM lithography, but NOT required during the NPGS training:**

| | |
|---|---|
| o Resist Spinner | - Suppliers of tabletop spin coaters are listed on the "Other Resources" page of the NPGS web site. |
| o PMMA | - Suppliers of e-beam resist are listed on the "Other Resources" page of the NPGS web site. When using PMMA, the 950k molecular weight PMMA will give the highest lithography resolution. The concentration of the PMMA purchased will determine the range of thicknesses that can be obtained by varying the spin speed. To lower costs and increase flexibility, one option is to purchase a relatively concentrated supply of PMMA and subsequently make other concentrations by diluting a portion of the concentrated PMMA with the appropriate solvent. |
| o Substrates | - A supplier of semiconductor wafers is listed on the "Other Resources" page of the NPGS web site. |
| o Acetone | - Used during lift-off with PMMA. |
| o Ultrasonic cleaner | - Sometimes used during lift-off with PMMA. |
| o Oven | - When using PMMA, the sample should be baked at 160C for >2 hours after it is spun onto the sample. Alternately, a hot plate can also be used to bake the sample after coating with PMMA. |
| o Stop Watch | - Used to time the development process. |

**Contact Info:**

**Joe Nabity, Ph.D.**
**JC Nabity Lithography Systems**
**(406) 587-0848**
**info@jcnabity.com**
**www.jcnabity.com**

 