The model VE-180 provides thin film coating of virtually any material quickly, cleanly and efficiently. Our system is equipped with 3 kW 4 pocket e-Gun, thickness monitoring, sample heater, and indirect temperature monitoring. A variety of evaporation source materials are available. The system has an ultimate vacuum on the order of $1.1 \times 10^{-7}$. 
Operation Procedure:

1) Log into both “Cr-Cleanroom” and “CR-Deposition System Thermionics” using FOM.

2) Note the system pressure before venting. It should be near or below 2e-6 Torr. If it is not, document the pressure in the FOM system and seek help from the NFCF staff.

3) Vent the system by placing the Mechanical Pump control switch in the off position. The red light should turn off. The venting process will take approximately 25 minutes.

4) If the system does not vent or the pressure stops increasing, log out of FOM and then log back in.

5) If it still does not vent within 30 minutes contact NFCF staff directly.

6) Do not leave the system venting/vented. It must be pumping unless you are loading the evaporation material or samples. Leaving the system venting drains our N2 supply!!

7) Turn on the Inficon rate monitor and press the “1” button to check the crystal life. The number approaches 100 as it nears the end of life. If it is 50 or more, note it in FOM and we will replace it.

8) Press the “PROG” button to enter the program screen. Use the up and down arrows to tab to the desired Z-factor and density parameters.

9) Enter the material density and the Z-factor into the rate monitor for the material being deposited. If you do not, the thickness will be based on the previous entry and your thickness will be inaccurate. The Z-factor and the density information for each material are located in the back of the user guide folder on the table near the evaporator.

10) Note: Do not edit any other parameters. The deposition controller is used only as a rate monitor and not a system controller.
11) Check that the controller is in the active mode. To place it in “active” mode press the stop and then the reset button from the main screen. The clock in the lower left hand corner should be counting up. This indicates that the rate monitor is “active” and ready.

12) Locate or request the desired material or materials to evaporate. Materials that are not located at the evaporator must be requested 24 hours in advance by e-mail. The materials will be delivered to the pass-through in the lithography area before the reserved machine time. Refer to the available source materials sheet for more details on location and user qualification.

13) Make certain the desired material fills from 50 – 80% of the crucible. If it is too full the material may boil over and if it is too low it can result in unstable rate, crucible and/or e-gun damage.

14) Prepare your sample by mounting it onto the sample holder. The sample cannot be larger in diameter than the sample holder or it will hit the rate monitor, heater or the thermocouple.

15) Once the system has reached a minimum pressure of 750 Torr (7.5e2) open the bell jar. Press and holding the up switch until the bell jar stops.

16) Turn on the shutter control power. Open shutter “A” to allow access to the e-gun. Turn the pocket selection knob on the front of the system to the correct pocket. The current pocket position is denoted by the number on the top of the dial.

17) Load the evaporation material into the appropriate pocket. Load multiple materials for multi-layer and note the pocket location. Close the shutter.

18) Load the sample holder into position at the top of the bell jar. Make certain that it locks into the recessed position. From the bottom the holder locks counter clockwise and releases clockwise.
19) Check the microscope slide covers for the viewport glass and replace them if they are coated.

20) Wipe the o-ring and sealing surface with a clean wipe and IPA.

21) Lower the bell jar and center it.

22) Pump down the chamber by pressing the mechanical pump switch to on and noting the red light illuminates. The pump down cycle should take around 10 minutes.

23) Make certain the chamber pressure reaches a minimum of 5 X 10^-5 Torr. Processing at higher levels can result in contaminated films, high voltage arcing and an unstable process. Be patient! Wait for good vacuum.

24) Turn on the power to the e-gun power supply, the heater (if using it), and the beam sweep.

25) Turn on the heat if desired. Remember that due to the location of the thermocouple, the temperature reading is only an estimated reference and not an accurate representation of the sample surface.

26) Turn on the substrate motor for rotation if desired. Rotation of the sample holder can help with film uniformity and more even heat distribution.

27) On the power supply remote, make certain that the emission control potentiometer is fully counter-clockwise; note that the “zero start” and the “ready” button are lit on the remote control.

28) Turn on the high voltage by pressing the “HV ON” button. Make certain that it is stable by placing the toggle switch in the “voltage” position and observing that the meter sits at “.4” and remains stable. The toggle will return to the “current” position.

29) Note that the beam control has three adjustment parameters for both the X and Y directions:
   a. The scan speed. (frequency)
   b. The scan width. (amplitude)
   c. The Beam position. (position)
30) Begin to prepare the source for evaporation:
   
a. Turn off the frequency and amplitude for both the X and Y directions. (Rotate both knobs fully counter clockwise)
   
b. Slowly ramp up the beam emission.
   
c. Watch for the needle on the current meter to begin to move slightly.
   
d. Watch for the beam in the pocket by viewing through the port window.
   
e. Locate the initial position of the beam. Be careful not to ramp the power too quickly and make certain of the beam position. If current flow is indicated on the current meter, you should be able to see the beam.

31) Ramp up the current slowly and evenly. Ramping to fast can result in thermal shock to the crucible and wasted material or damage in the chamber. A minimum of 5 minutes ramp up and down for easily evaporated materials and a minimum of 10 minutes ramp for high temperature materials such as platinum.

32) Note that the blue emission of the beam is located in the crucible pocket. Adjust the beam position using the X-Y position control. Use a gentle sweep of as much of the material as possible during the rise and soak procedure.

33) Keep it in the center of the pocket. Turning the frequency and amplitude off can help you to see the true center of the beam. Be careful to heat the material evenly and not to “tunnel” through the material. Materials like chrome sublime and the sweeping action of the beam becomes required.

34) Use previous process parameters from your past runs or the logbook to estimate the power levels needed for evaporation of a given material. Remember that this is only a reference and that the beam position, sweep, crucible thermal contact and the level of the material in the crucible also affect the evaporation rate.
The best reference is to carefully view the material while heating it and note that it is evenly heated and approximately 75% of the current necessary for evaporation. If the glass slides are becoming coated, the rate is too high and the power should be reduced. The idea is to be just below the evaporation temperature. Molten but not evaporating.

Note the thickness reading on the crystal in the upper right hand corner of the Inficon display. Press the “zero” button to clear the thickness number before starting the deposition. If it does not “zero”, press the stop button followed by the reset button to make sure the controller is ready. The clock should be counting up and the thickness should read 0. The clock can be used as a timer reference for ramping up and down during process.

If the screen shows a “crystal failure” contact NFCF staff for repair.

Open the shutter and immediately check the rate on the deposition controller.

Slowly adjust the emission current to the desired rate. Rate levels can be adjusted during the process. Many users prefer a slow initial rate for the beginning film growth and a faster rate later in the process for thicker films.

Once the desired thickness has been achieved, close the shutter. Slight adjustments to the beam current may be required during deposition to maintain a stable processing rate.

After completing the deposition/closing the shutter, slowly ramp the emission current back to zero. It is necessary to take a couple of minutes for normal materials and 5-10 for high temperature materials. This process avoids thermal shock from rapid cooling.

Record as many process parameters as possible. Base pressure, deposition pressure, and beam current are a few excellent examples. This helps all users maintain their process and helps to keep the machine information available for everyone.
43) Turn off the high voltage, the e-gun power supply, the heater, the rotation and the X-Y sweep.

44) If you are doing multiple layers, switch the pocket to the new position, zero the thickness, and enter the density and Z-factor for the new material. Start once again at step 23.

45) Allow time for hot samples to cool before venting. This will help avoid rapid oxidation and stress of your film.

46) When the chamber is ready, switch the mechanical pump switch to “off”. Wait approximately 25 minutes for the system to vent and reach 7.5e2 Torr.

47) Once vented, open the bell jar, open the shutter, remove any crucibles and remove the sample holder.

48) Replace the microscope slides for the viewport. Make certain that they are all in place and fully mounted into their individual slots.

49) Wipe down the o-ring and sealing surface with IPA and vacuum up any delaminating material or particles.

50) Close the bell jar and pump the system down immediately to maintain vacuum integrity for the next system user.

51) Remove the sample from the holder and return the crucible material to its correct location. Precious metals must be returned to the Cleanroom pass-through.

52) Fill out the logbook data sheet.

53) Turn off the shutter control and the rate monitor.

54) Note that the vacuum level has dropped into the -5 Torr range.

55) Log out of FOM.
Source Materials for use with Thermionics e-Beam Evaporator

Materials available to all users and located in Cleanroom Deposition Area

Chromium
Hafnium
Nickel
Silver
Titanium
Molybdenum Oxide
Germanium
Zirconium
Ruthenium

Materials available to all users and located in the Office

- Must be requested 24 hours in advance
- Surcharge for use of Gold and Palladium