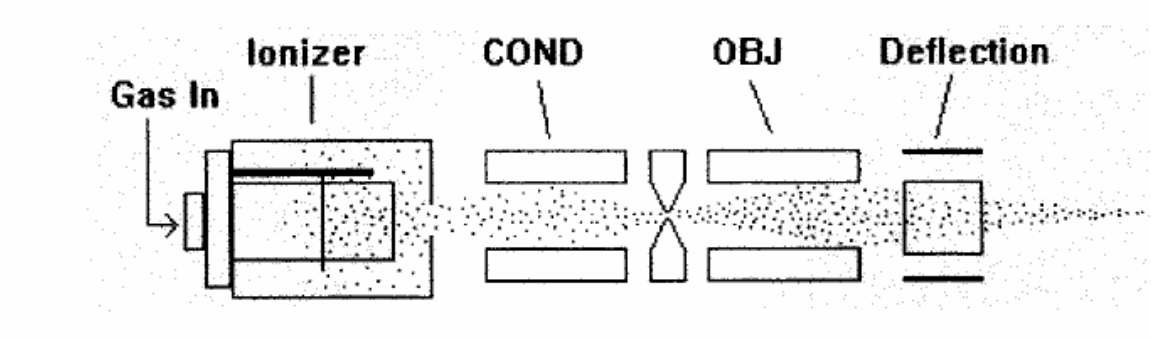
www.rbdinstruments.com

04-303 Ion Gun Theory, Operation and Alignment

The 04-303 Ion Gun, when used with the 11-065 Ion Gun Control, generates a reproducible ion beam that can be used for sputter cleaning and depth profiling.

There are four principal sections to the ion gun: the ionizer assembly, condenser lens, objective lens, and deflection plates. These are shown below.



The ionizer assembly is where the ions (usually of argon) are generated by accelerating electrons from a hot filament through a grid into the ionization region. The ions generated have the same potential as the beam voltage. A higher beam voltage produces more ions of a higher energy than a lower beam voltage. Typically, a beam voltage of 4kV is used for maximum beam current. The beam voltage supply will go as high as 5kV, although arcing is more likely at 5kV. If your ion gun arcs at any voltage, RBD offers a complete rebuild service.

The condenser section compresses the ion beam. The value on the condenser (COND) dial on the 11-065 is a relative number that represents a percentage of the beam voltage. Typical values are 500 (turn the knob fully clockwise) for the smallest possible ion beam spot size, and approximately 340 for the maximum beam current.

The objective section focuses the ion beam on the sample. Typically, the gun is operated with a focused beam in order to get the sharpest possible interface when doing a depth profile. In some instances, it is desirable to de-focus the beam in order to reduce the sputter rate.

The deflection plates provide the raster voltages that deflect the beam over a specified area. The maximum area that can be sputtered is 1 cm x 1 cm. This corresponds to a setting of 10 x 10 on the raster size potentiometers on the 11-065 ion gun control. Varying the raster size is one of the ways that the sputter rate can be easily changed.

The table below shows the typical operating parameters for the 04-303 ion gun.

Typical Operating Parameters for the 04-303 Ion Gun				
To Achieve the Following Results		**Use the Following Parameters**		
Total Ion Beam Current (Approximate)	**Ion Beam Spot Size (Approximate)**	**Beam Voltage**	**Condenser Voltage**	**Objective Voltage**
150nA	200uM	4kV	500	340
8uA	1000uM	4kV	340	360

04-303 Ion Gun Operation

Basic Operation:

1. On the 11-065, set the Emission/Pressure meter switch to Emission. Make sure that the scale switch is in the X1 (times one) position.
2. Press the Diff Pump Ion Gun button on the AVC remote, or manually pump the ion gun.
3. Slowly turn up the Emission knob until you have 25mA of emission current (X1 position).
4. Switch the Emission/Pressure meter switch to Pressure.
5. Slowly open the argon leak valve on the 04-303 ion gun until you have 15 mPa of pressure on the meter. This corresponds to approximately 2×10^{-8} torr when differentially pumped, and 2×10^{-7} torr when not differentially pumped.

You are now ready to sputter. When you turn the ion beam voltage on, the ion gun will be sputtering.

Alignment: Visual Method
This works in both ABS and SED image modes. SED mode is sometimes easier to work with.

1. Insert a SiO_2 sample and position it to the focal point of the analyzer. Use 30^o to 60^o of tilt.
2. Get a low magnification image of the SiO_2. Use a low electron beam voltage, such as 1.5kV in order to get the largest possible image size (the lowest possible magnification).
3. Set up the ion gun as discussed above. Set the condenser to 5.00 (the smallest spot size) and the objective to 3.40.
4. Turn on the ion gun beam voltage. If the electron beam current and the ion beam current are approximately the same value, the ion beam spot should be visible on the TV monitor.
5. Mechanically adjust the position of the ion gun (turn the thumb screws) to center the ion beam spot on the TV monitor. Adjust the OBJ for the smallest spot size.

6. If you cannot see the ion beam due to too much ion current (you totally lose the TV image), set the emission scale switch to the X1 position. This will reduce the ion beam current to 10% of its previous value. The ion beam spot should be visible. If not, mechanically adjust the ion gun. Total ion beam current should be approximately 150nA with the condenser lens at 5.00 and the emission at X1.

Alignment: Faraday Cup Method

1. Insert the faraday cup and center the hole on the TV monitor.
2. Move the X axis of the stage slightly so that the hole is just off to the side and do an elastic peak to set the faraday cup to the correct focal point of the analyzer.
3. Move the faraday cup back to the center of the TV monitor.
4. Press the Ion Current button on the 18-175 keyboard. The electron beam will be blanked automatically and the ion current will be displayed in the beam current section of the keyboard.
5. Set up the ion gun (26mA emission current, 15 mPa argon) and turn it to ON. Make sure that the raster on the 11-065 is set to OFF.
6. Adjust the thumbscrews on the ion gun to mechanically maximize the Ion Current reading. Also, on the 11-065 adjust the COND and OBJ knobs for maximum current. Go back and forth between mechanical and electronic adjustments until the current is maximized.
7. You can fine-tune the mechanical position of the ion gun with the Deflection Position knobs on the 11-065.