

Agar Filaments (K-type) for JEOL Microscopes

AGA092

Abstract

K-type filaments are pre-aligned hairpin filaments for use in transmission electron microscopes. When installing a new filament we recommend using newly cleaned (and carefully dried) cathode and anode assemblies. For optimum gun performance it is important that the K-type filament be set precisely at the correct height with respect to the Wehnelt.



Recommendations

| | |
|-----------------|--|
| Bias | 5, 6 or 7 |
| Filament height | Set 1.3 turns back |
| Filament heater | Set at 5 to 6.5 |
| Beam current | 200kV typically 25 to 30uA 100kV typically 15 to 20uA |
| Vacuum | Better than 10^{-3} mbar Avoid water vapour contamination |
| Saturation | Avoid oversaturation: some faint residual structure in the image is acceptable for most work |

Typical Running Conditions

When inserting the new filament adjust the height until, with the Wehnelt viewed edge-on, the filament tip is level with the external surface. There are five full divisions on the cathode assembly and each full division has a half-spacing marked: hence the height setting is calibrated on one tenth of a full turn on the screw thread used for height adjustment. Set the correct filament height by turning back by 1.3 turns. This is sometimes only achieved with an error of 0.1 turns (see below). Now insert the cathode (and a clean anode) before pumping to achieve the best working gun vacuum attainable. Hopefully this is better than 10^{-5} mbar. With the bias set at 6, slowly heat the filament over a period of 15 minutes aiming for a heater knob setting of about 6. Retaining roughly this setting of the heater knob, adjust the bias to achieve a position of 'just-at-saturation' for a reasonable beam current (see recommendations). Note, some faint residual structure in the filament crossover image is acceptable - users report that for most TEM work heating to exclude every last trace of shading is not necessary

Given that slight adjustments to filament heating may now be necessary:

- ◆ If 'just saturated' is achieved at a bias of below 5 then the beam current will probably be a little low, and the distance the filament has been set back is slightly too great
- ◆ If the 'just saturation' is achieved at a bias of above 7, then the beam current may be high and the distance the filament has been set back is too small
- ◆ If the HT is stable, but the filament cross-over image flickers, then it is likely that the filament has not been set far enough back

If the filament height is not set satisfactorily, cool the filament, open the gun and reset the height by no more than 0.1 turn, in the direction indicated above. Repeat the running-in procedure.

When the correct height / centration / beam current / bias is achieved, at the start of its life it is advantageous to run a tungsten filament for at least one hour under-saturated. Users report that this has an effect of improving performance.

Notes:

1. During normal use some users prefer to heat the filament over a period of minutes, others take only 30 seconds.
2. Users report lifetimes in excess of 120 hours for filaments, which are carefully run-in and used with care.
3. Some users report that whiskers of tungsten occasionally grow in the JEOL Wehnelt aperture. This is not a function of the filament type: it occurs in conditions where there may be water-vapour contamination of the microscope (typically from using poorly desiccated film), and/or where the electron is used for long periods at an emission current which is excessively high.