

## Sample and Experiment Details

Sample Name:	Allectra <u>301-KAPM-060</u> wire Batch: <u>20415</u> Reel: <u>FA1-181751</u>	Sample Quantity	One wire
Measurement	Electron beam irradiation	Sample Dimension	Wire length: 0.5 metre



Figure 1: Image of the 301-KAPM-060 wire sample mounted on the electron-beam chamber sample holder.

A coiled length of Allectra radiation-hard wire (part number: 301-KAPM-060-50M, batch number: 20415, reel identifier: FA1-181751) has been tested under an electron beam to investigate its vacuum compatibility during radiation exposure.

The wire sample was mounted on a holder (as shown in Figure 1) at the base of a rotatable manipulator which also features a phosphor square for electron beam alignment. The electron gun used for these measurements is located on a dedicated test system at the Diamond Light Source and is pumped using a combination of a  $300 \text{ l s}^{-1}$  ion pump and a  $300 \text{ l s}^{-1}$  turbomolecular pump. During the measurements, with the electron gun at operating conditions and the RGA on, the pressure measured in the system was better than  $4 \times 10^{-9}$  mbar, note that the system was unbaked.

The gun conditions used produced a drain current of  $1 \mu\text{A}$  on the phosphor square and this drain current was stable over a period of at least one hour.

## Results

Residual gas analyser (RGA) data has been collected from the system and a comparison of spectra obtained before and after electron beam exposure is shown in Figure 2. The expected low mass peaks (from  $H_2$ ,  $H_2O$ ,  $CO/N_2$  and  $CO_2$ ) all behave similarly before and during exposure, with the observed reduction in pressure between the measurements due to additional pumping time. A single peak at mass 69 is seen with the electron beam on the wire and this typically indicates the presence of a fluorocarbon material (such as PTFE). However, the partial pressure of this peak is not characteristic of radiation-induced breakdown which typically results in pressure spikes up to 200x larger than the background.

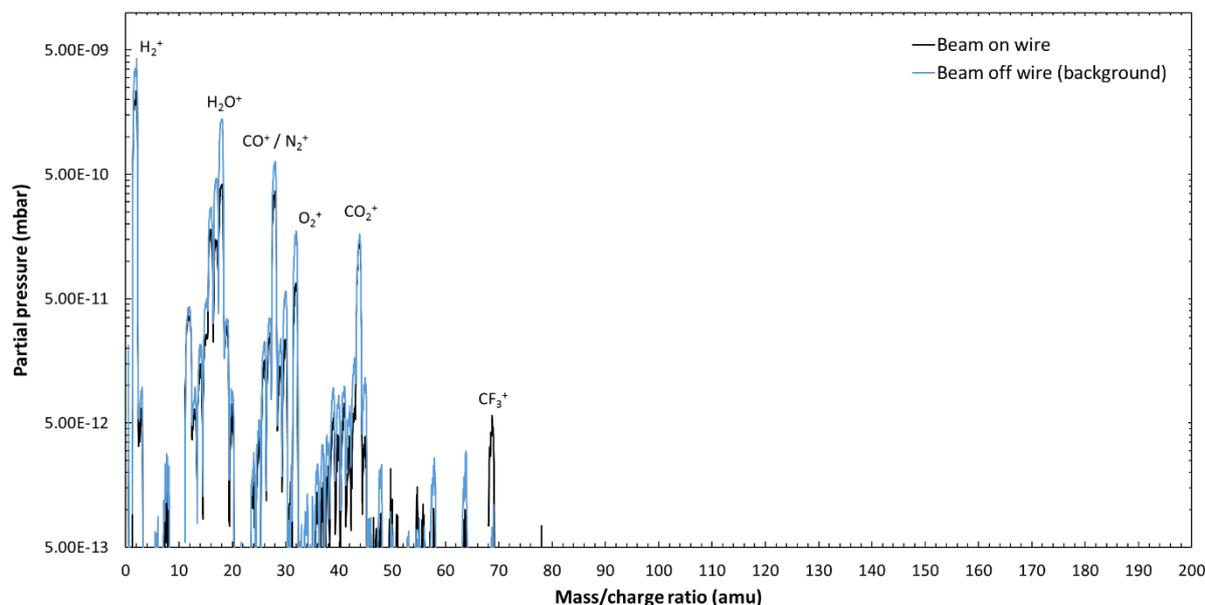


Figure 2: RGA spectra comparison from before (blue curve) and during (black curve) electron exposure.

A comparison of RGA scans with the beam on the wire and then on the empty sample holder (with no wire loaded into the test system) is shown in Figure 3. In this case, the partial pressures of the mass 69 peaks are similar and so the  $CF_3^+$  fragment observed when the wire is loaded is likely from small patches of contamination on the sample holder.

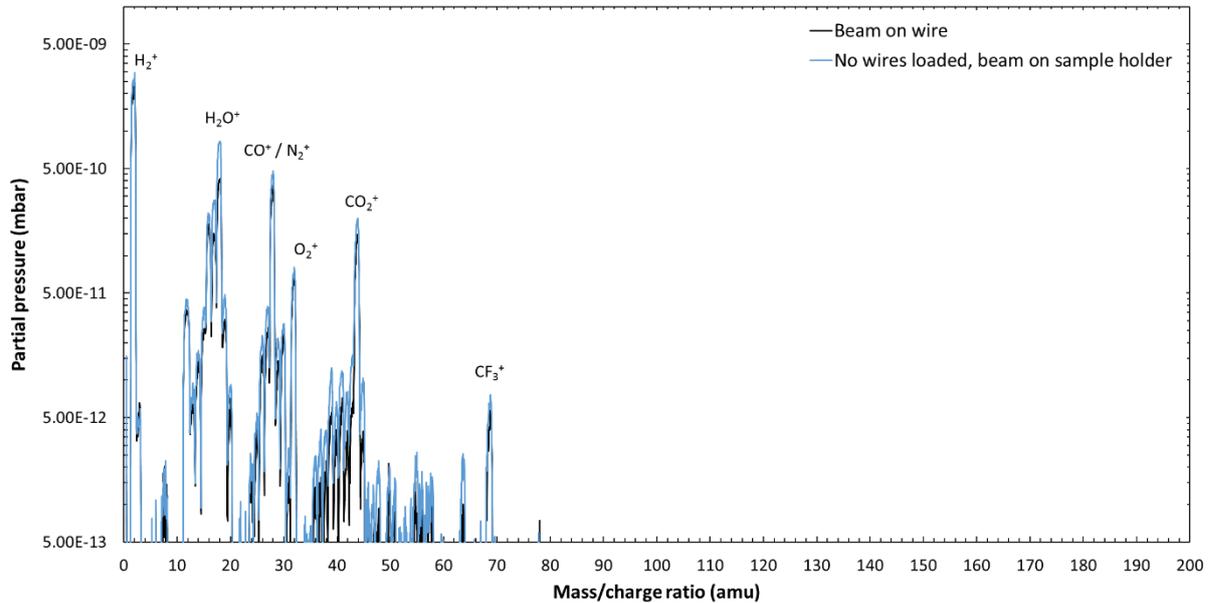


Figure 3: RGA spectra comparison with and without the wire loaded, in both cases the electron beam is on the wire.

Shown below in Figure 4 is RGA trend data highlighting the pressure variation in the system over a 15 minute period with the wire exposed to the electron beam for five minutes. In particular, the total pressure and partial pressures of two fluorocarbon fragments (CF<sub>3</sub><sup>+</sup> and C<sub>2</sub>F<sub>4</sub><sup>+</sup>) are shown over two short repeat measurements.

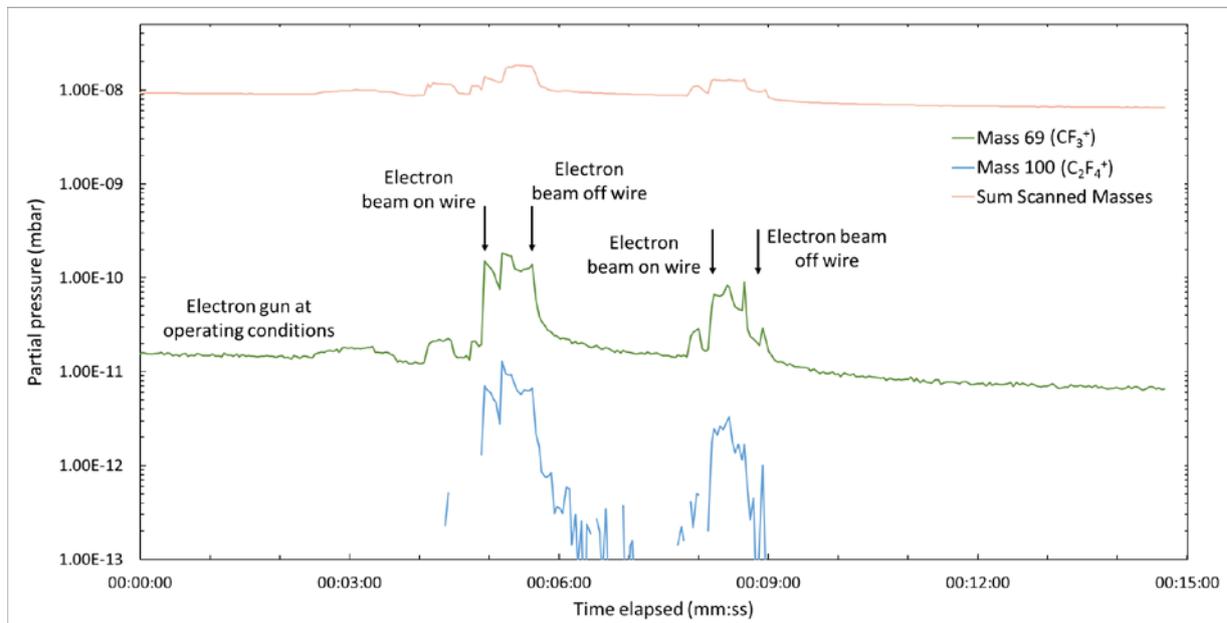


Figure 4: RGA trend data showing the behaviour of the total system pressure and fluorocarbon fragment partial pressures.

From Figure 4, it can be seen that the mass 69 partial pressure (corresponding to CF<sub>3</sub><sup>+</sup> fragments) increases by a small amount (less than a factor of ten) after exposure to the electron beam. This small pressure spike is also much less than typically observed from PTFE containing wires. Similar behaviour is seen for the peak at mass 100 (although the measured pressures are at the limit of the RGA), which

correspond to  $C_2F_4^+$  fragments, and so the observed spike is likely due to a small amount of PTFE. Based on Figures 2 and 3, and supported by the trend data in Figure 4, the small signal at mass 69 amu with the beam on the wire is from the sample holder and not the wire itself.

### **Conclusion**

The 301-KAPM-060 wire sample is not seen to contain any fluorocarbon material and the small signal that is observed is from small patches of residual contamination on the sample holder.