IEUVI Resist Technical Working Group

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Anthony Keen, Carolyn Hughes BOC Edwards
Paul Blackborow Energetiq Technology Inc.

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Experimental set-up

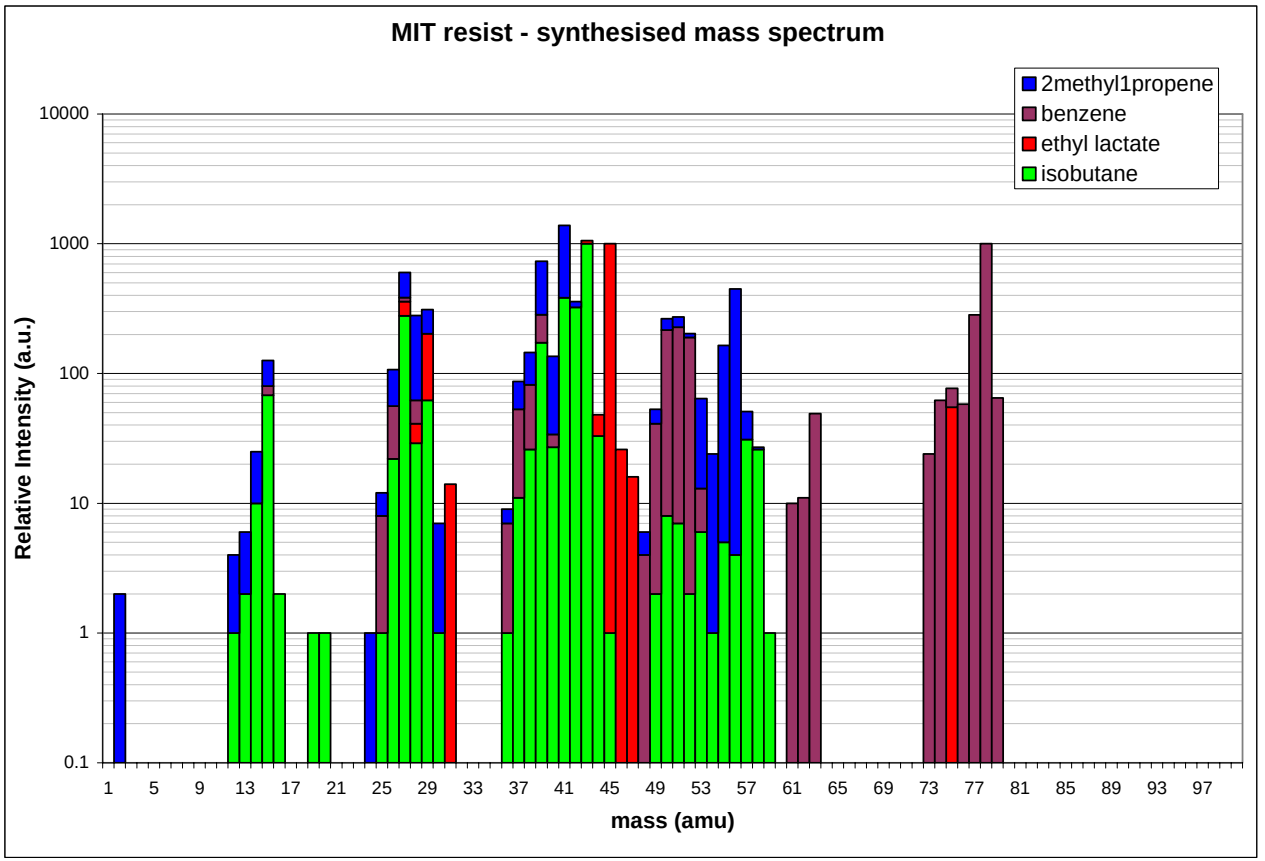
- Outgassing measurements were performed using a 200 amu residual gas analyser (RGA / QMS).
- The pumping speed at the chamber was approximately 15 l/s.
- The system base pressure was better than $1x10^{-8}$ Torr, rising to 5×10^{-7} Torr during exposure. The practical sensitivity limit of the RGA was $1x10^{-12}$ Torr.
- The wafer samples were positioned 90cm from the plasma, at an angle of incidence 45^{o} to both the EUV beam and the RGA.
- Exposures typically performed with the sample under vacuum for 1 hour before exposing, although longer time (+24 hours) also investigated.

Exposure Conditions

- Measurements were performed using EUV light from an electrodeless z-pinch gas discharge source.
- Exposure conditions:
- For the low power exposures a dose of 1mJ/cm^2 is reached in approximately 87 seconds exposure.
- For the high power exposures a dose of 1mJ/cm^2 is reached in approximately 1 second exposure.
  - High power exposure is achieved through burst mode operation, 2 second burst with 20% duty cycle.
- EUV light was filtered by a 200nm thick zirconium foil, size 1cm^2, resulting in an exposure area at the sample of 0.5cm^2

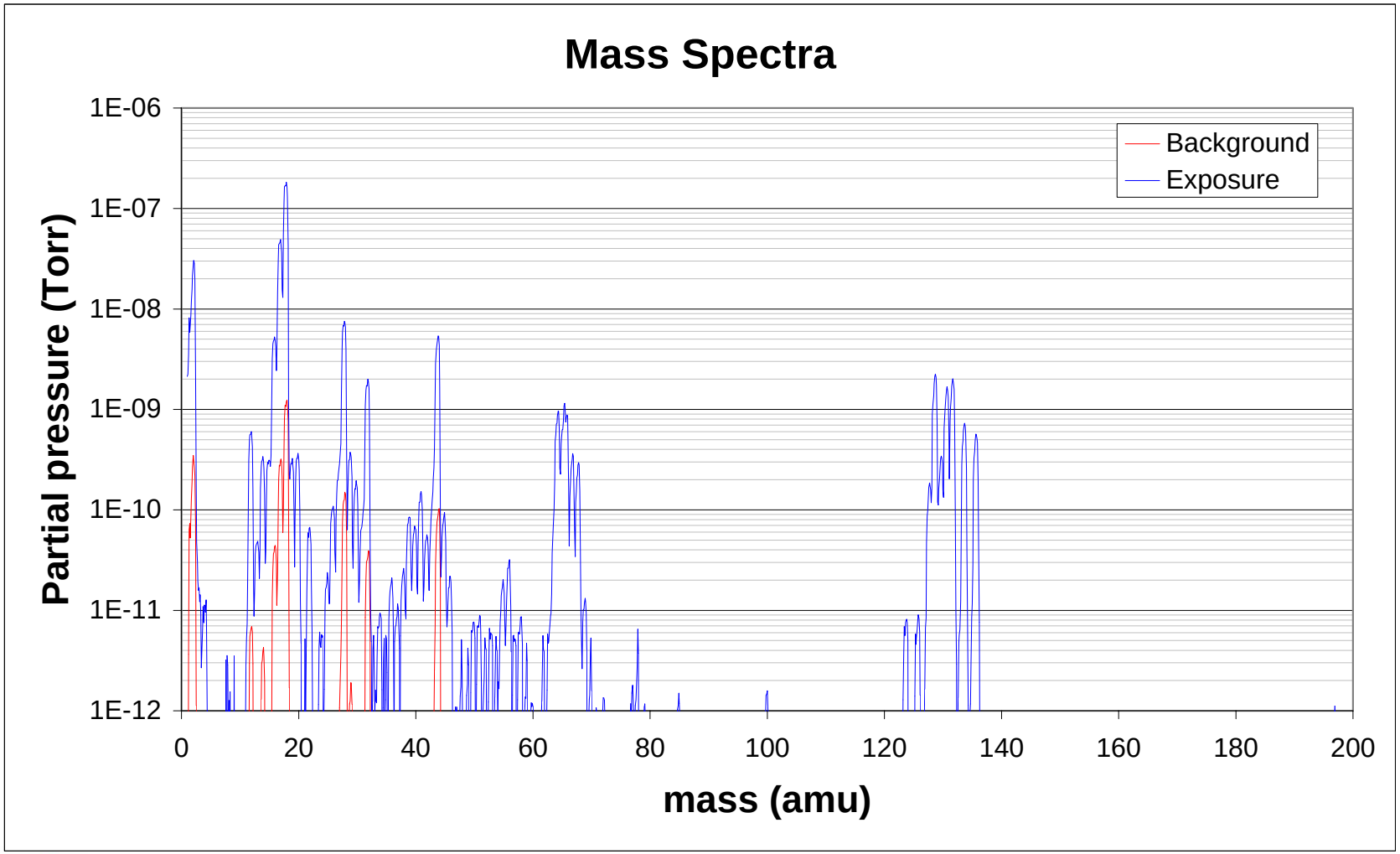
Photo-Resist Details

- 2 methyl-1-propene
  - Parent ion at 56amu
  - Dominant species 41amu
- Benzene
  - Parent ion at 78amu
  - Dominant species 77amu
- Isobutane
  - Parent ion at 58amu
  - Dominant species 43amu
- Ethyl lactate (solvent)
  - Parent ion at 118amu
  - Dominant species 45amu

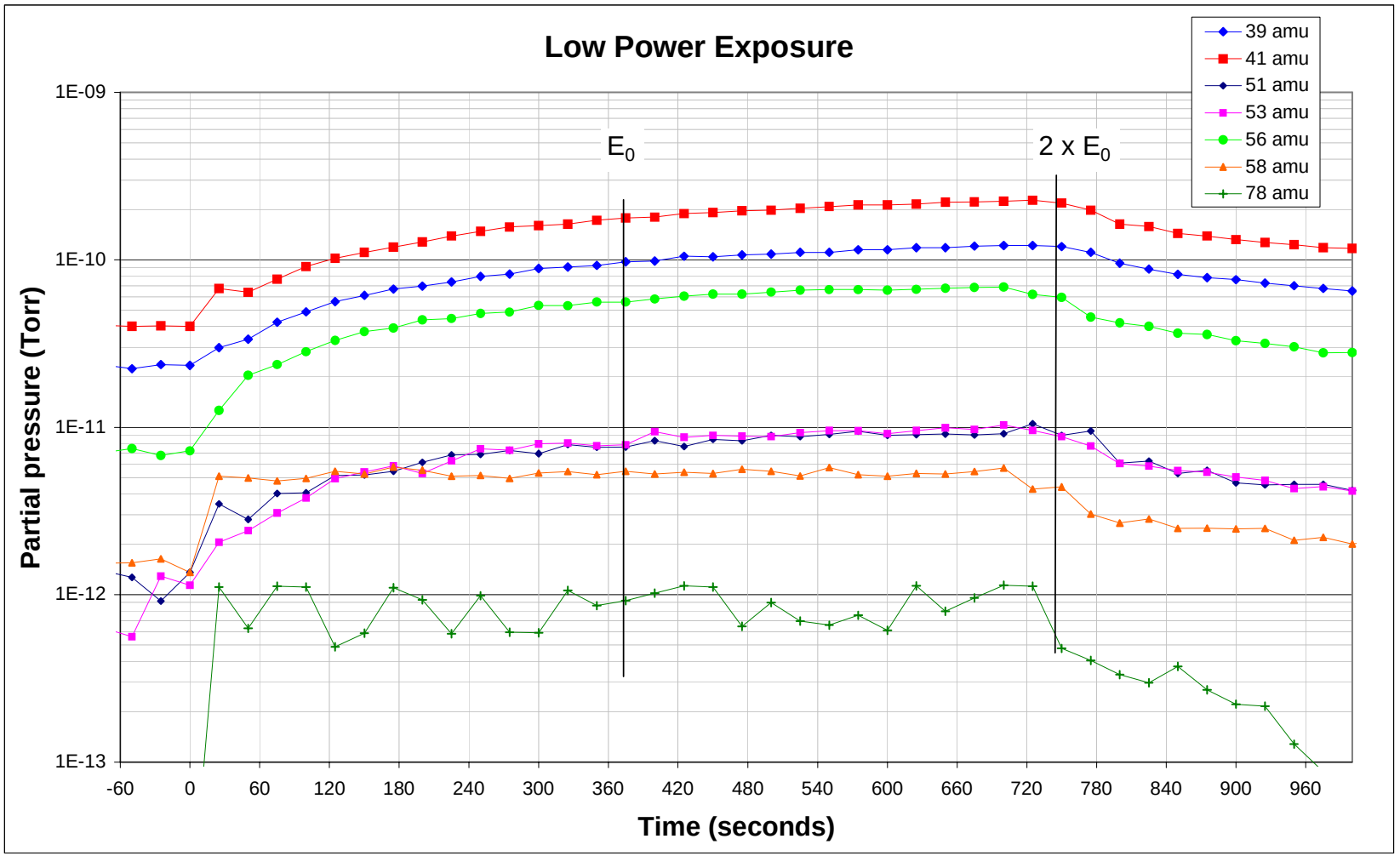


- Exposure dose to clear resist 4mJ/cm^2

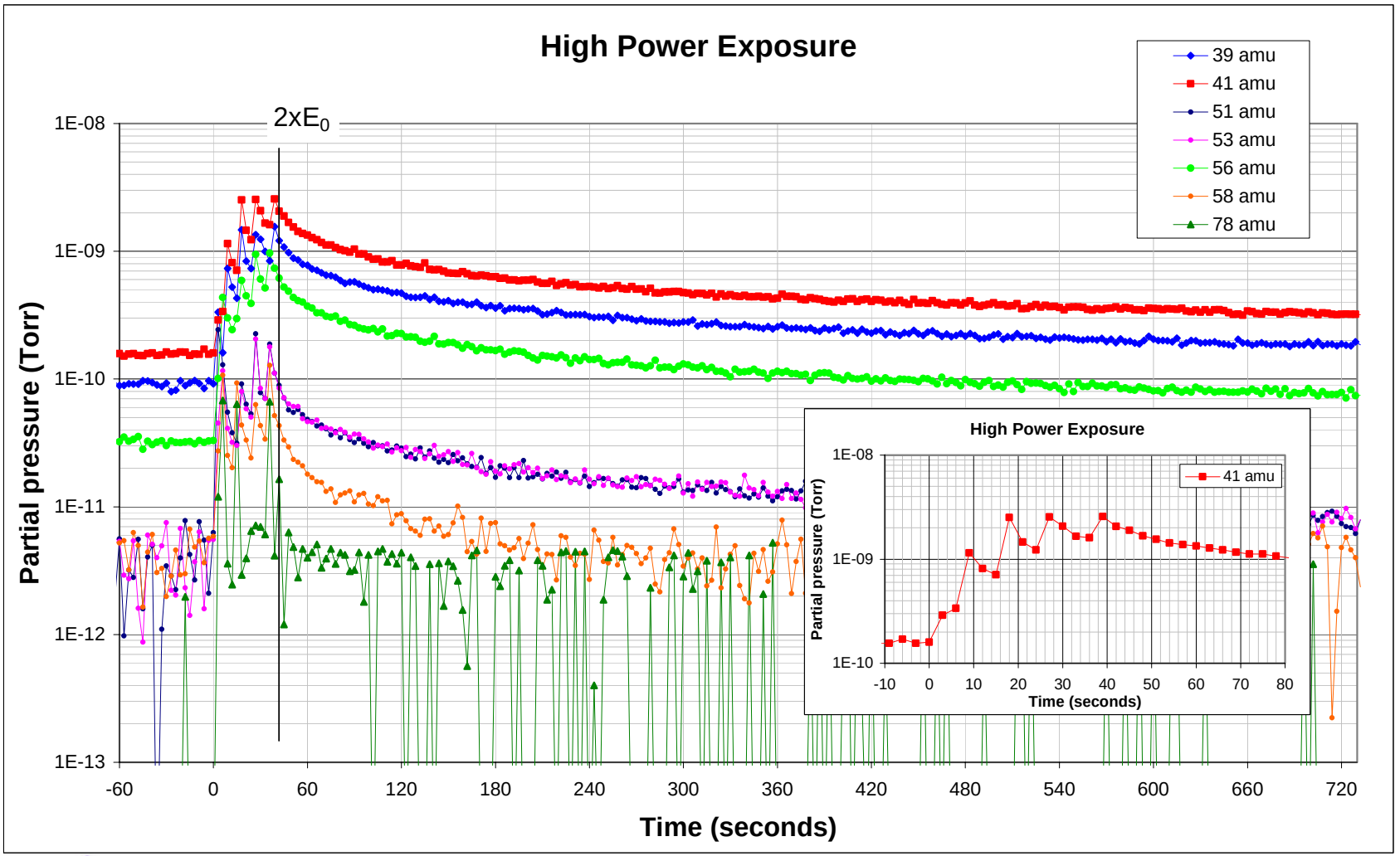
Limitations of RGA



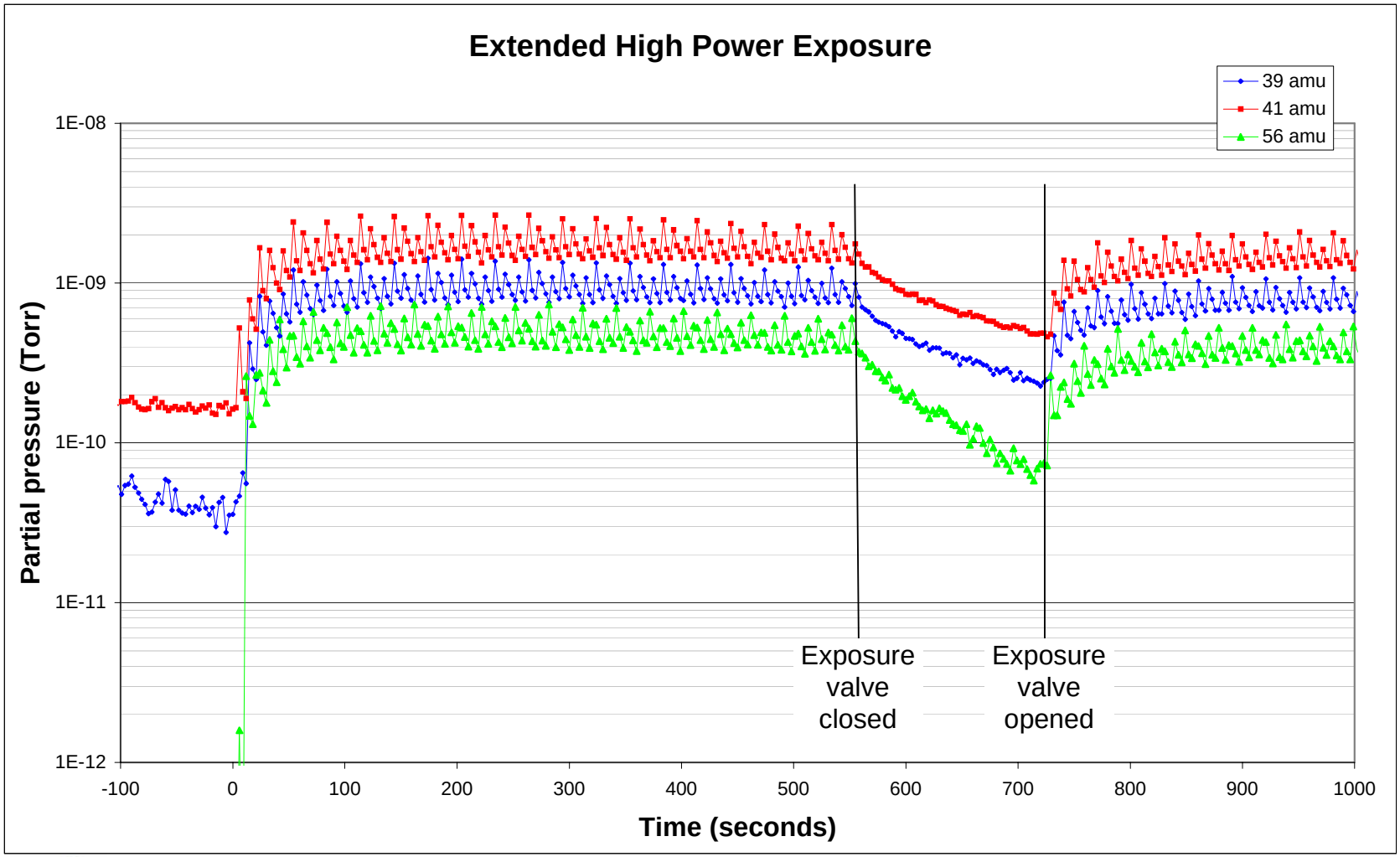
Low Power Exposure



High Power Exposure



Extended High Power Exposure



Preliminary Conclusions

- Specific outgassing has been observed at 39, 41, 43, 51, 53, 56, 78amu under exposure conditions where the sample is under vacuum for a short period of time before measuring, approximately 1 hour.
  - 39, 41 and 56amu are likely from of 2-methyl-1-propene
  - 78amu is characteristic of Benzene
  - 58amu is evidence of isobutane.
- The outgassing rate (partial pressure level) is observed to increase by approximately one decade from ‘low’ to ‘high’ power exposure conditions.
- Extended ‘high’ power exposure displays no significant increase, or decrease, in outgassing rate as a function of time (during the term of the experiment).
- Possible dependence on time under vacuum before exposing and measuring.
  - During one series of measurements the sample remained under vacuum for 30 hours before exposure and in this case there was no observable outgassing above 56amu.