

NIST tools to characterize resist outgas and analyze stepper contaminants

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Elements of the NIST Methods

A. Resist qualification, two characteristics to be determined:

1. Total resist outgassing rate (molecules/cm²)
 - Mechanical measurement of pressure rise in sealed chamber
2. Identification of molecular components
 - Cryotrap outgas products from sealed chamber
 - Subject cryotrapped sample to GC/MS

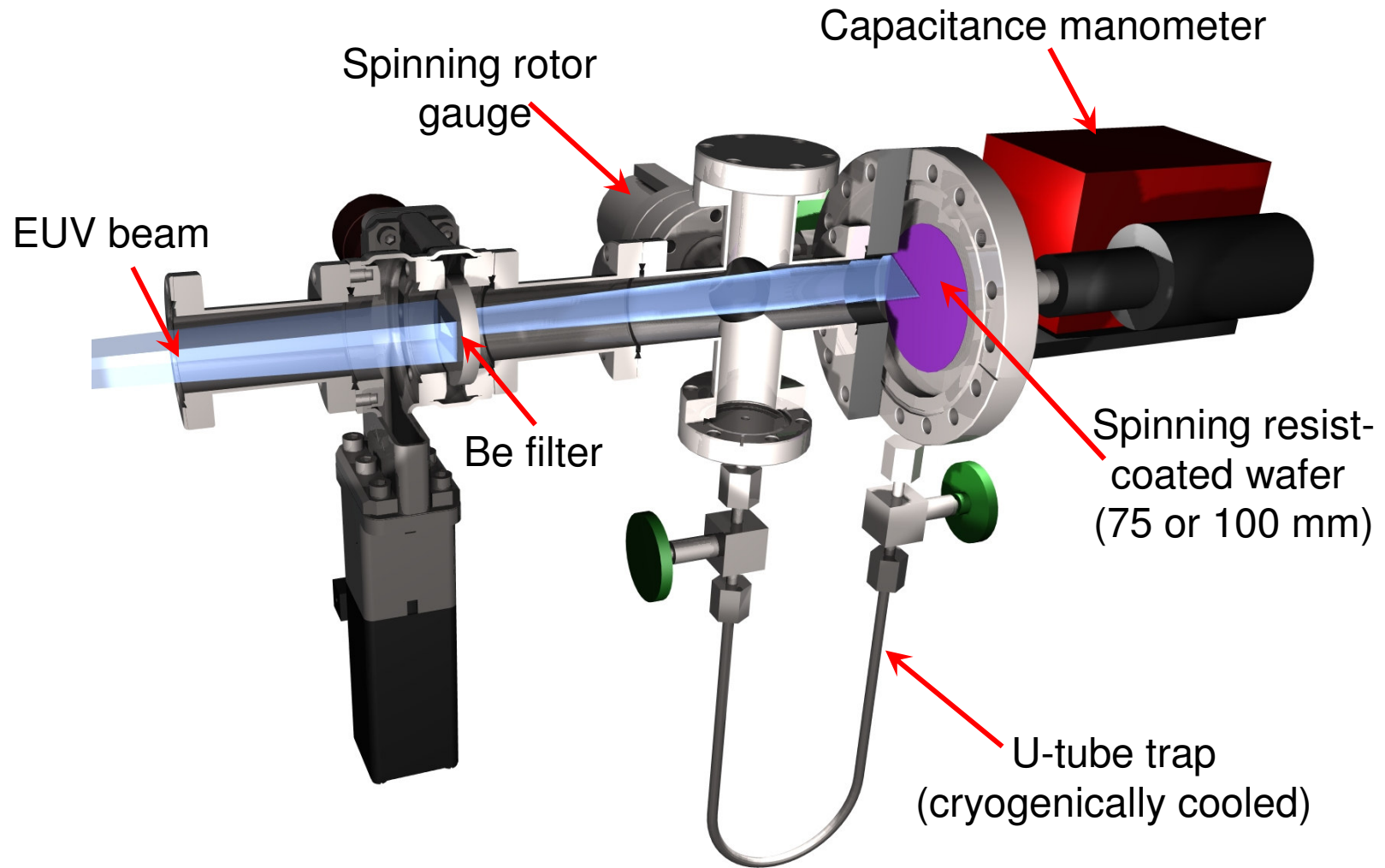
B. Stepper contamination

- Cryotrap contaminants in trap filled with inert, high surface area material
- Identification of molecular components by subjecting trapped sample to GC/MS

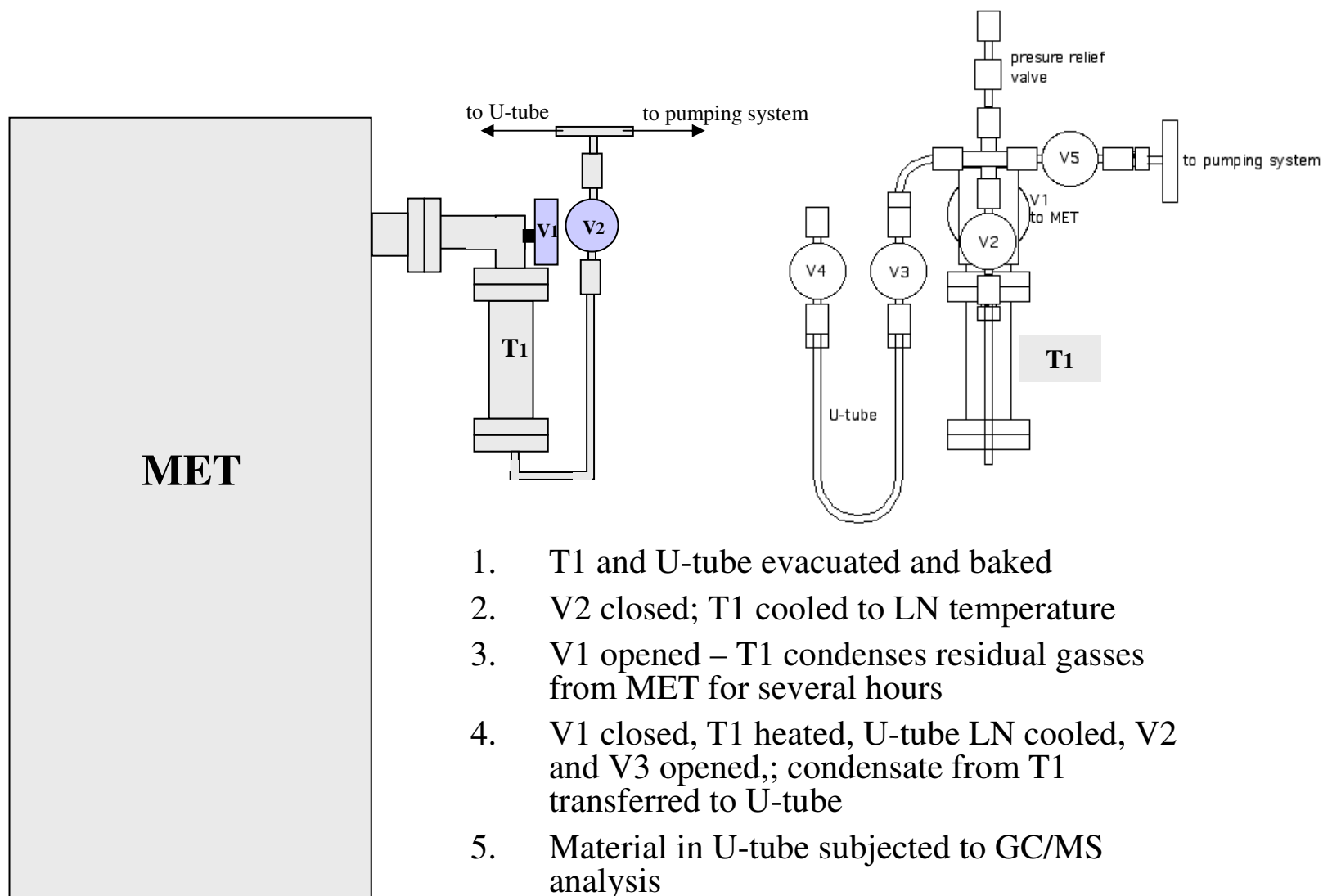
Advantages:

1. Measurement of pressure is independent of molecular species (for **A.1**)
2. Cryotrapping indiscriminate – traps practically everything of interest except CO
3. GC/MS removes much of the ambiguity connected with fragmentation in the MS
4. Cryotrapping + GC/MS can be made fairly quantitative

Schematic of NIST System

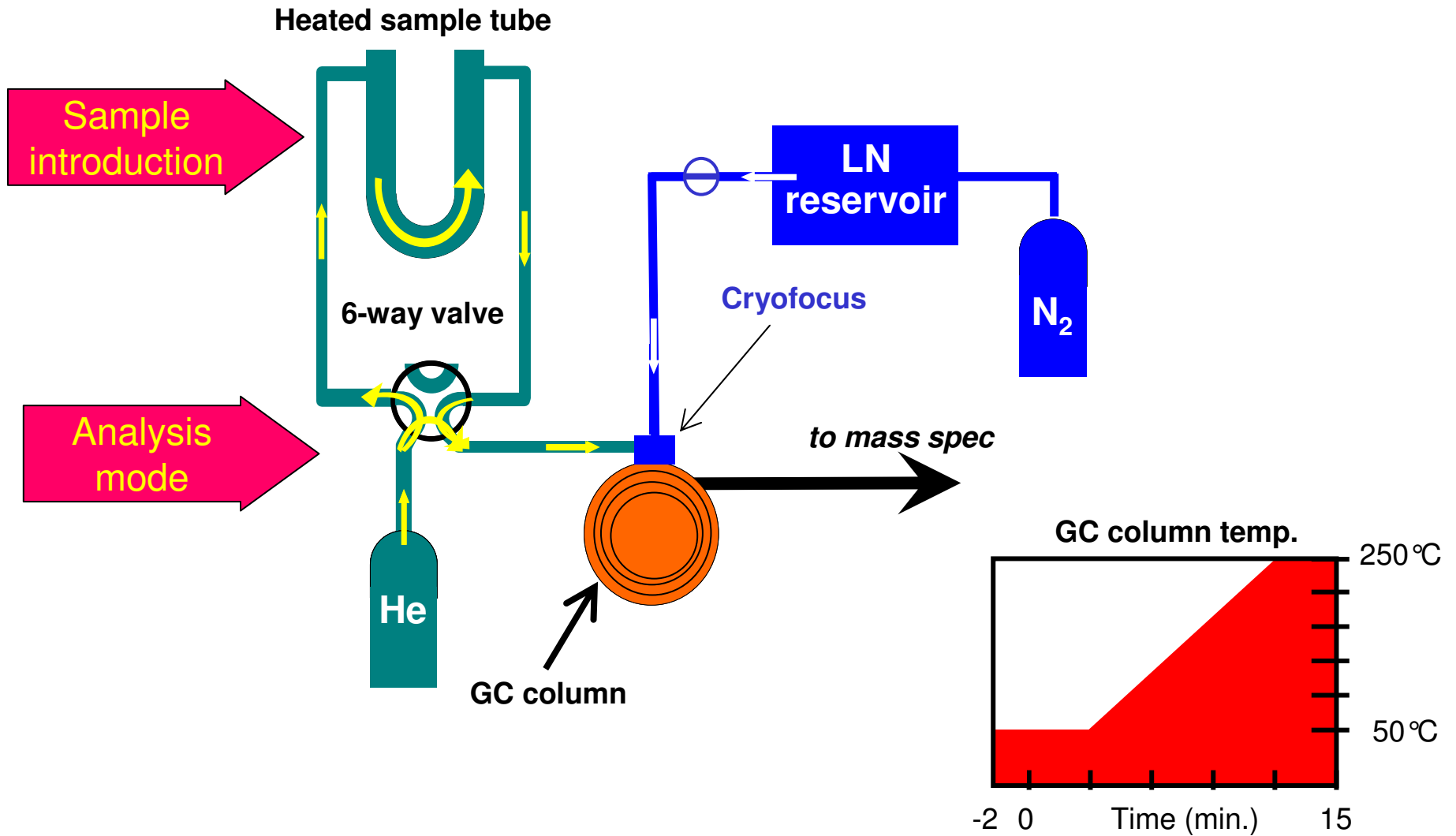


Schematic of Cryotrapping Method

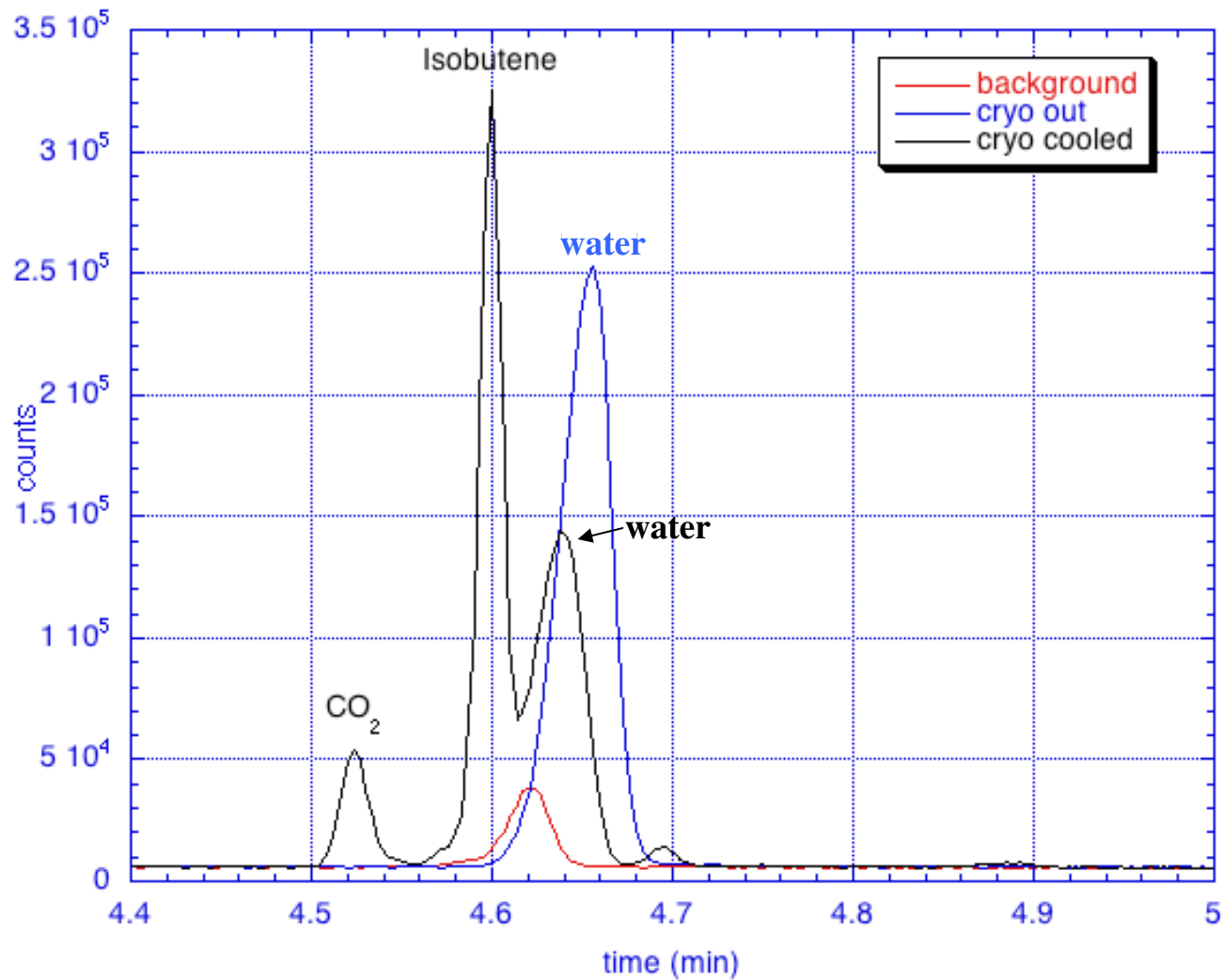


T1 filled with high surface area inert material

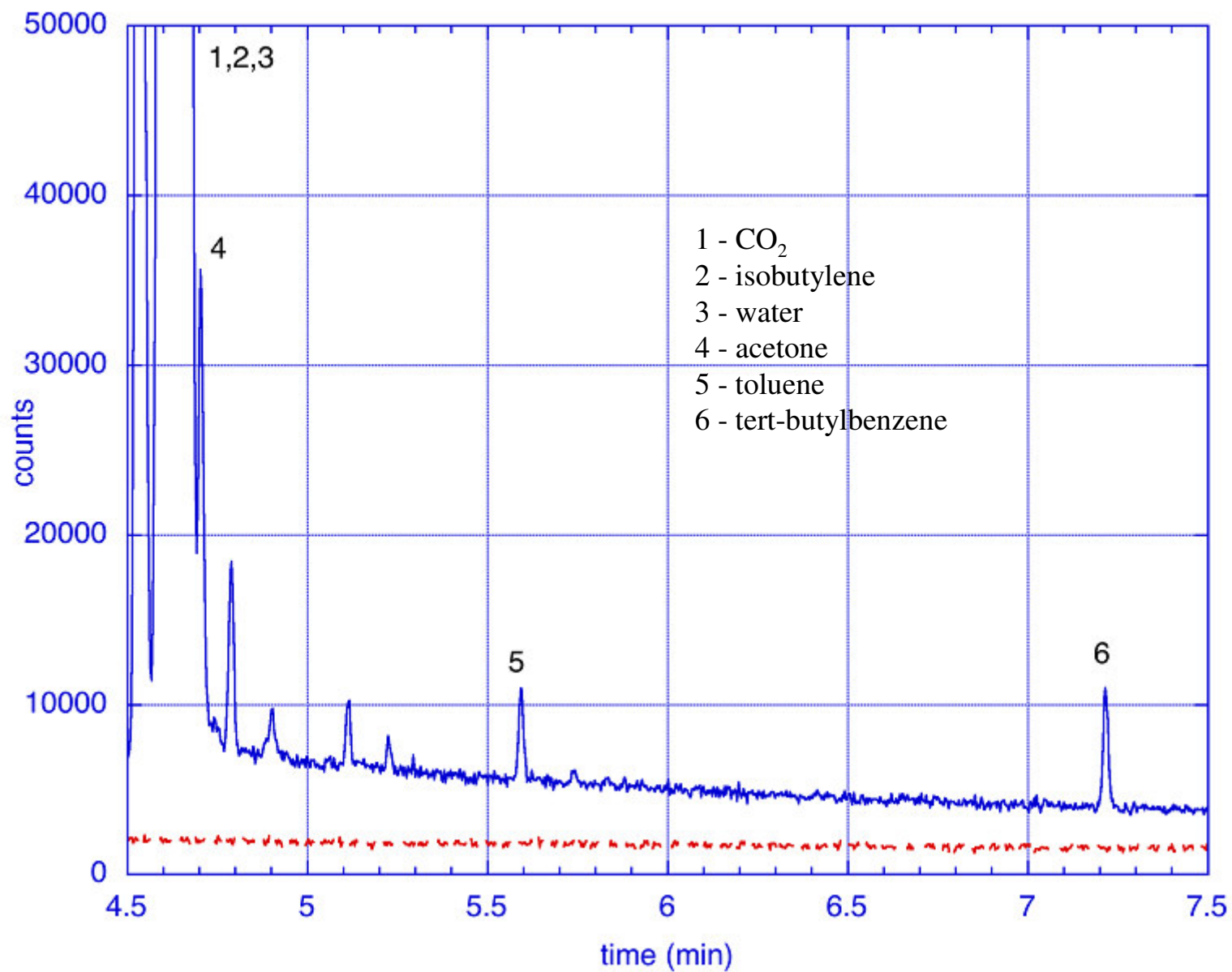
GC/MS with cryofocus



Cryofocus advantage



Total ion chromatogram



Summary

- Mechanical measurement of absolute pressure rise provides stable, repeatable measurements of resist area outgassing rate without further calibrations
- GC/MS with cryofocus well suited to analyze samples with species having widely varying volatilities
- Cryotrapping of resist outgas components and of stepper vacuum systems provides representative samples with informative relative abundances for GC/MS
- Efforts underway at NIST to make method of cryotrapping + GC/MS analysis more quantitative

Back-up details

Capabilities available at NIST

Electron and Optical Physics Division

- SURF III EUV radiation source – well suited for radiometry, lifetime studies, etc.
- Expertise in UHV
- Extensive knowledge of EUVL metrology issues
- GC/MS instrument outfitted with cryofocus sample injection

Process Measurements Division

- Expertise in pressure measurement and vacuum system design

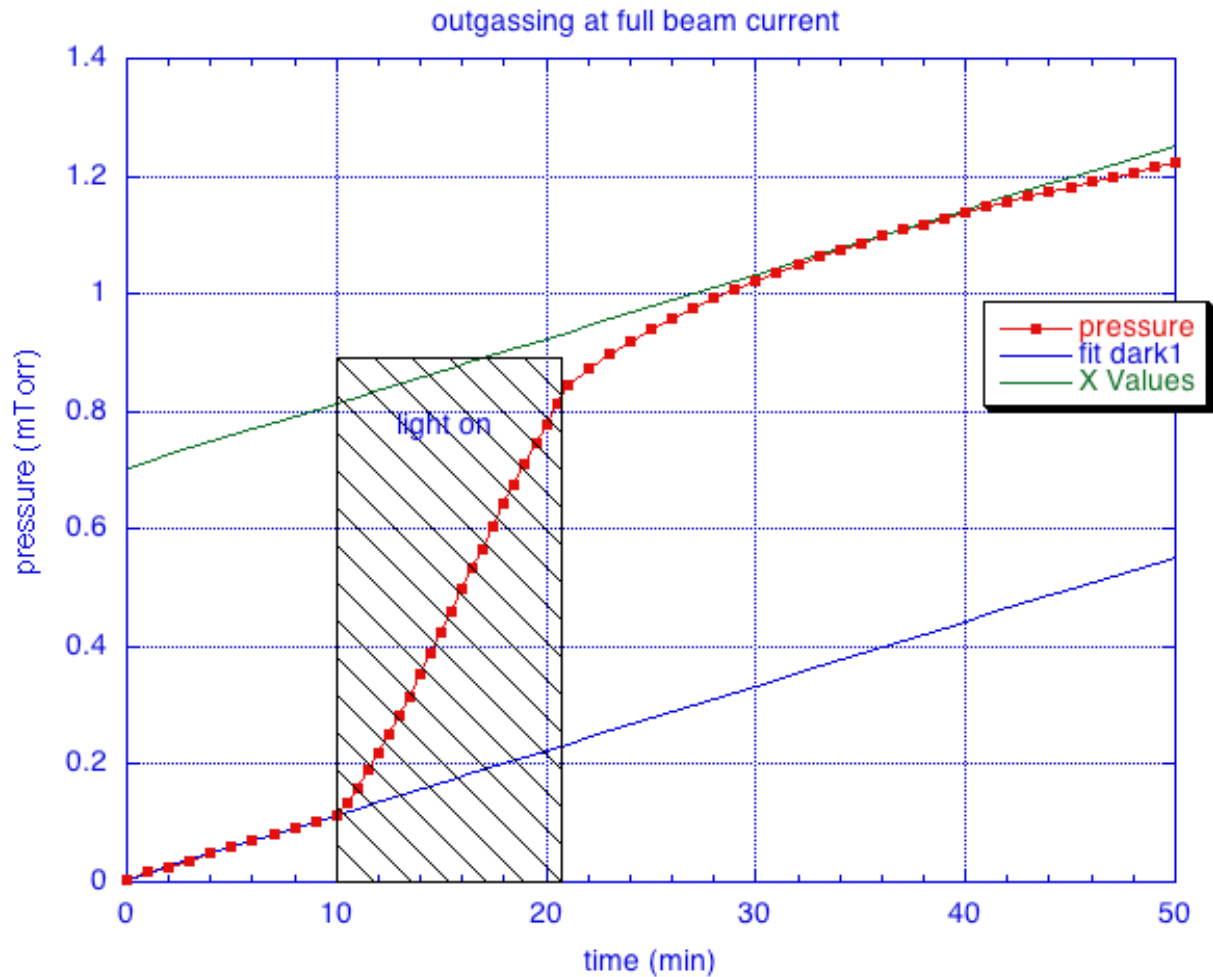
Physical and Chemical Properties Division

- Creators and maintainers of the NIST MS data base
- GC/MS expertise

Polymers Division

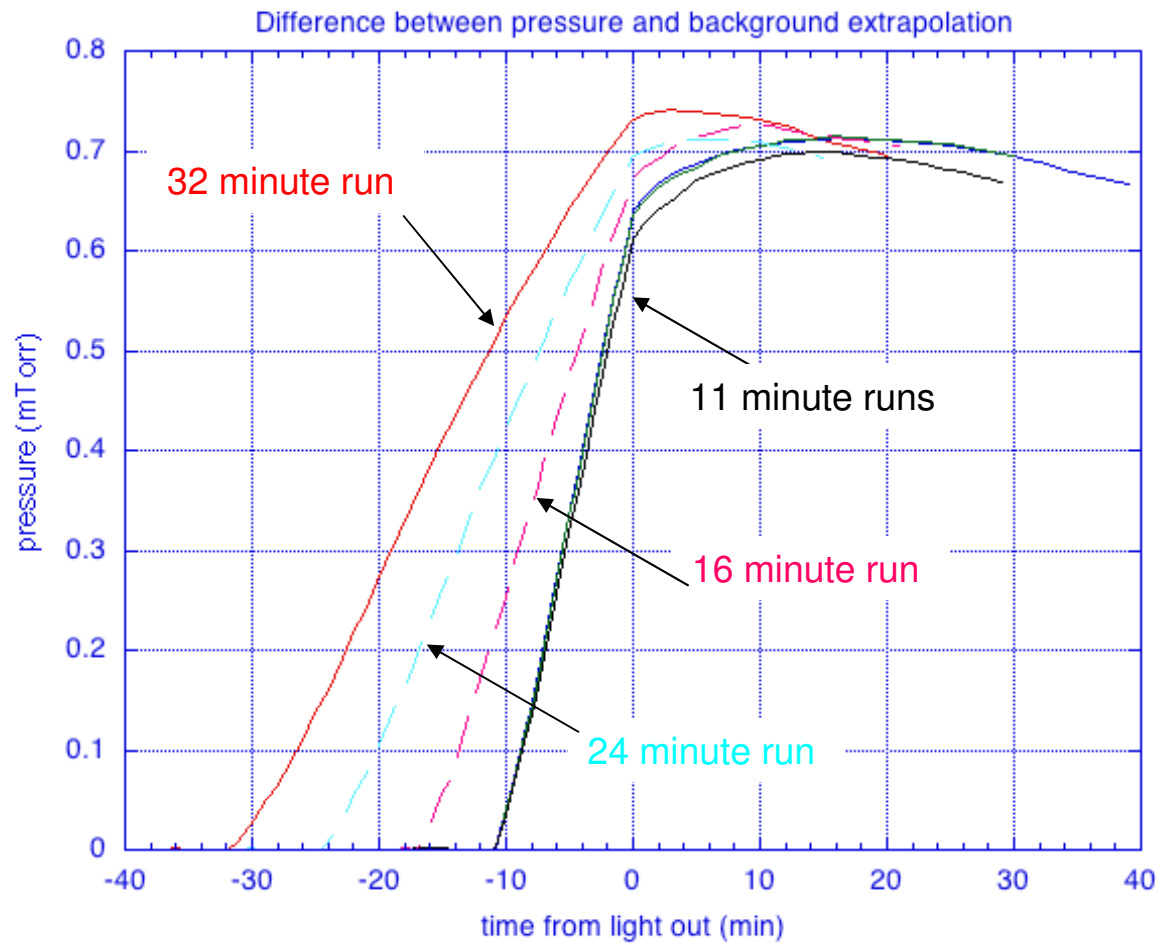
- Photoresist expertise
- DUV radiation source

Outgassing at SURF III



Outgassing remains elevated for several minutes

Outgassing at SURF III



Data from several runs made under varying conditions

Data Analysis (10+ runs)

post-exposure time (min)	average (10^{14} cm^{-2})	Std. dev. (10^{14} cm^{-2})	Std. dev.
0	2.77	0.20	7.2%
5	2.99	0.13	4.3%
10	3.11	0.06	1.9%
20	3.20	0.18	5.6%