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Photos placed in horizontal position with even amount of white space between photos and header

In-Situ Testing: An Exploration of Increasing Design Complexity

Brendan L Nation, Tomas Babuska, Michael T. Dugger, Nicolas Argibay

U.S. DEPARTMENT OF ENERGY

National Nuclear Security Administration

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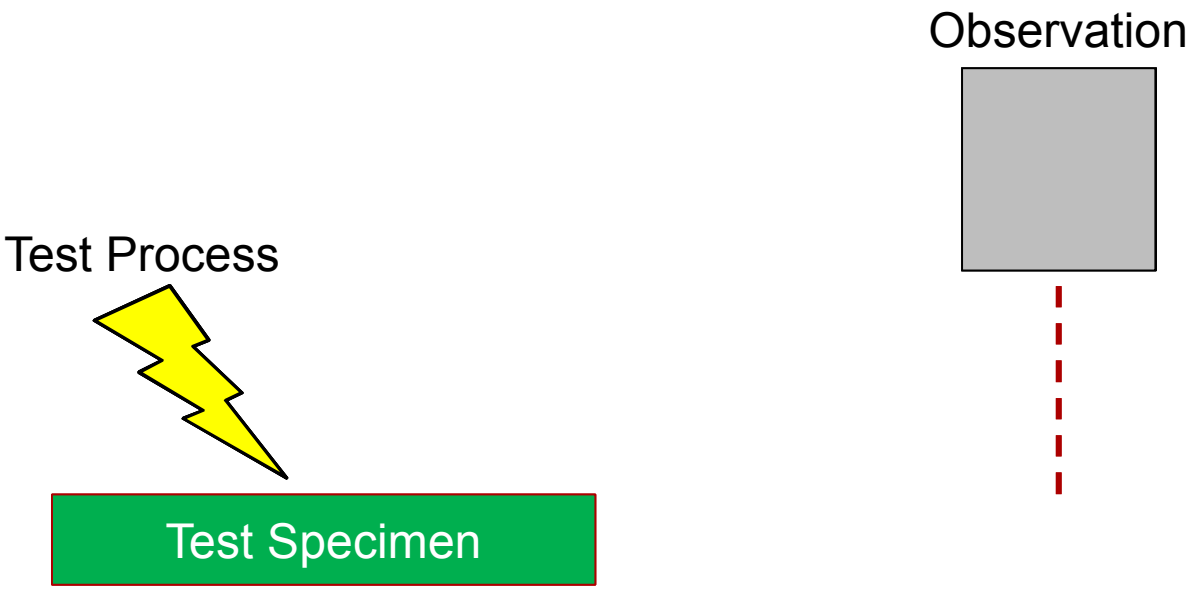
Outline

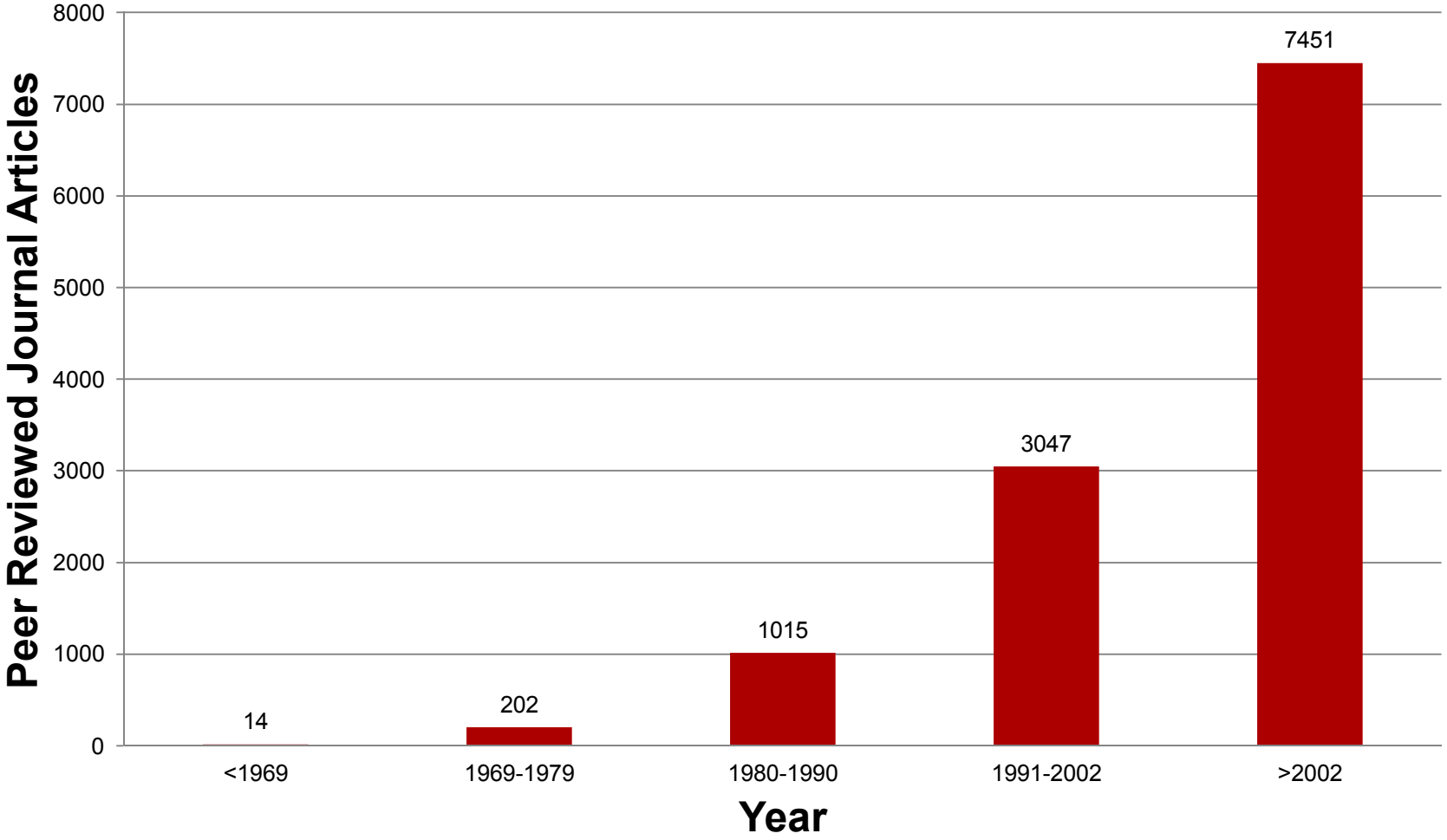
- Literature Search/Review
- Past Work
- Past Work- CSM/In-Situ 4-wire Tester (Commercial Modified)
- Cryo-Friction Stage
- SWLI-Tribometer
- Future Work/Ideas
- Conclusion

Definition

- In-Situ
  - Latin "in its original place or position"
  - More recently used in science to describe an experiment + characterization while conducting experiment



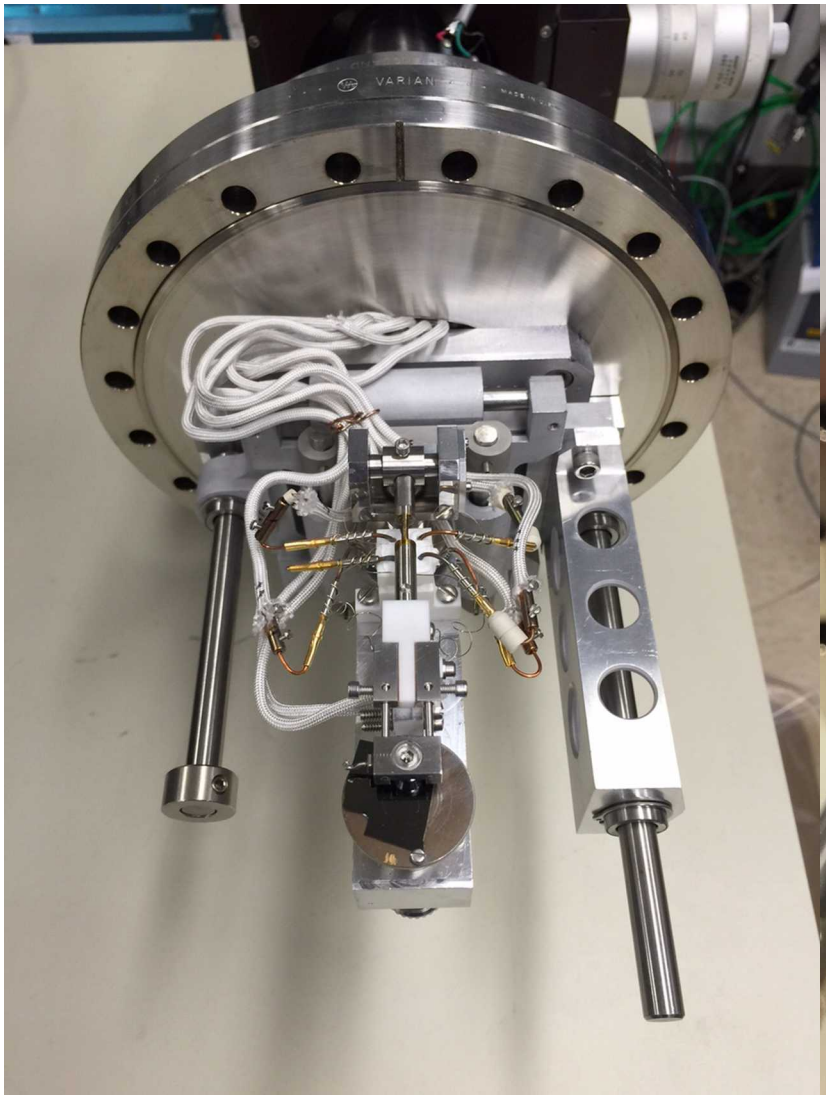
Literature Search

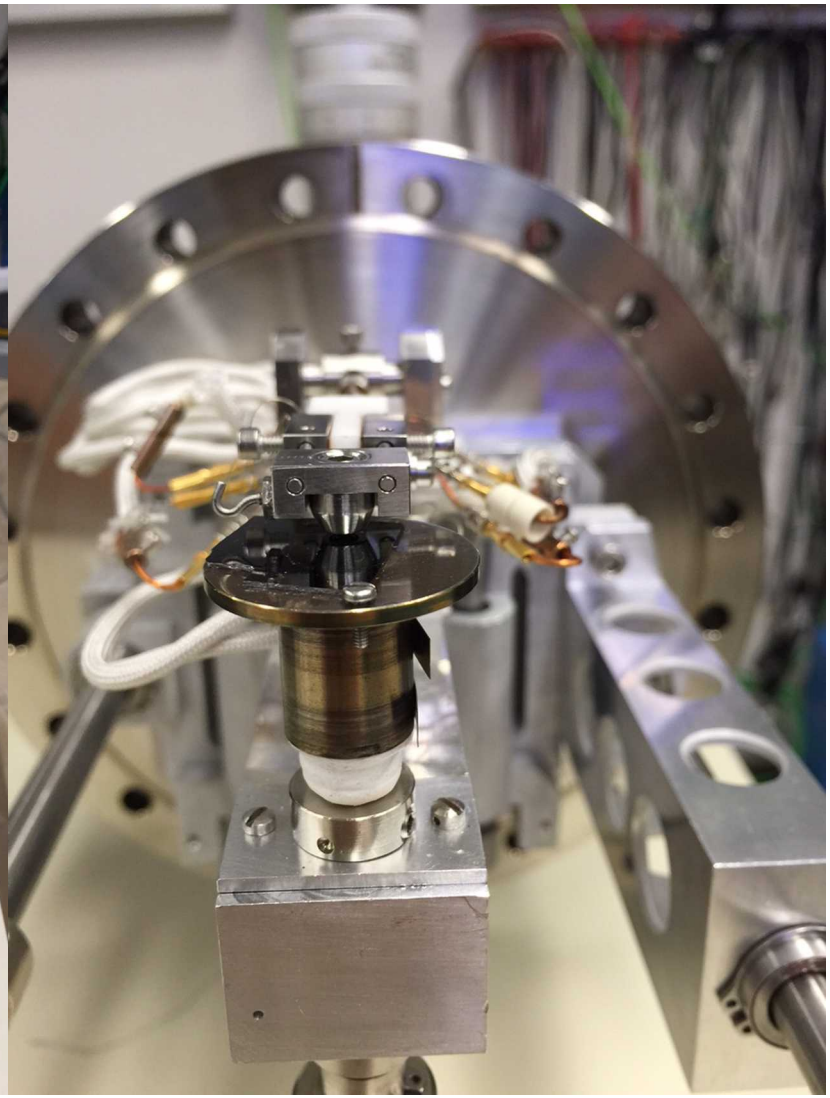


Sandia Technical Library Search “In-Situ”, 9/18/2015

Lupulescu, Alexandra I., and Jeffrey D. Rimer. "In Situ Imaging of Silicalite-1 Surface Growth Reveals the Mechanism of Crystallization." *Science* 344.6185 (2014): 729-32. Web.

Past Work-Auger Tribometer





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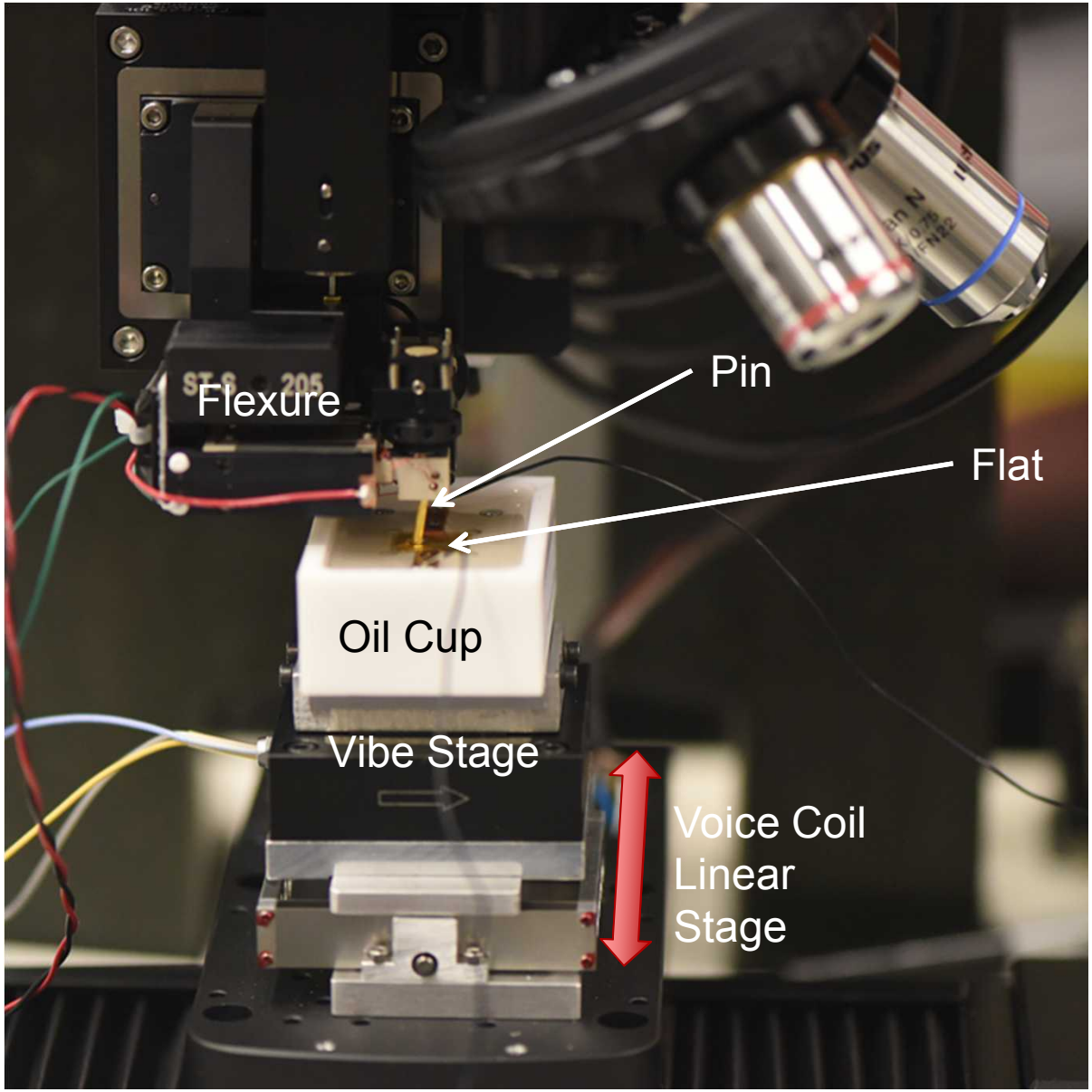
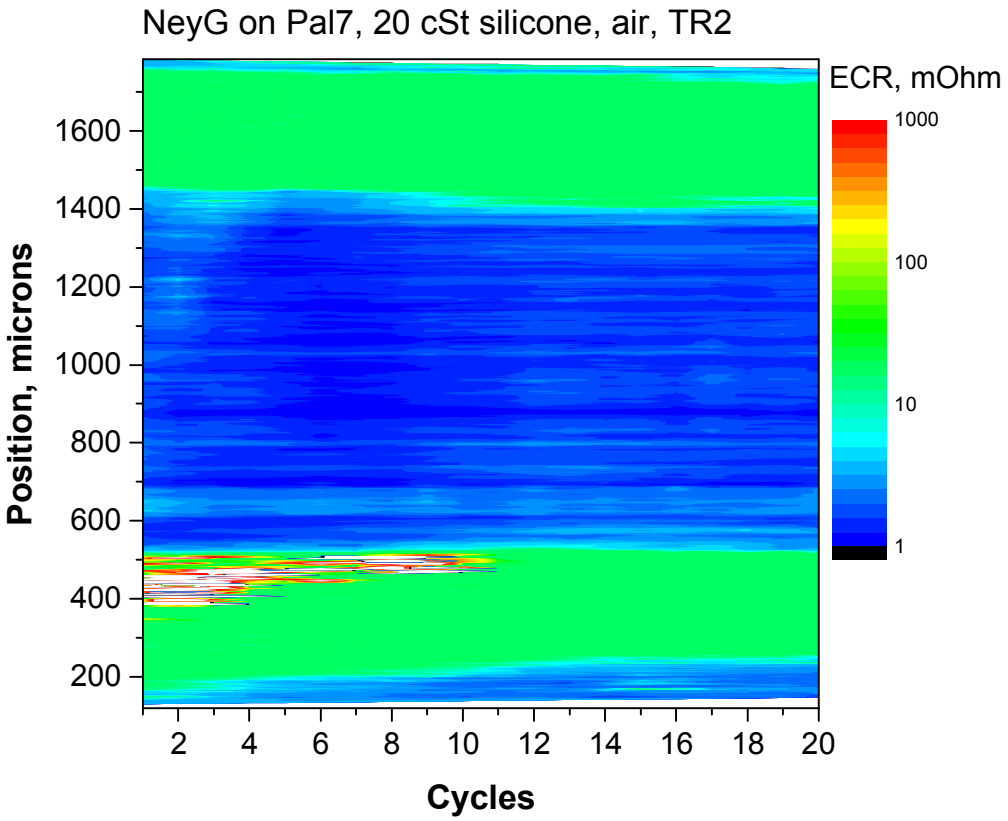
In-Situ ECR Measurement

CSM-Commercial Tester

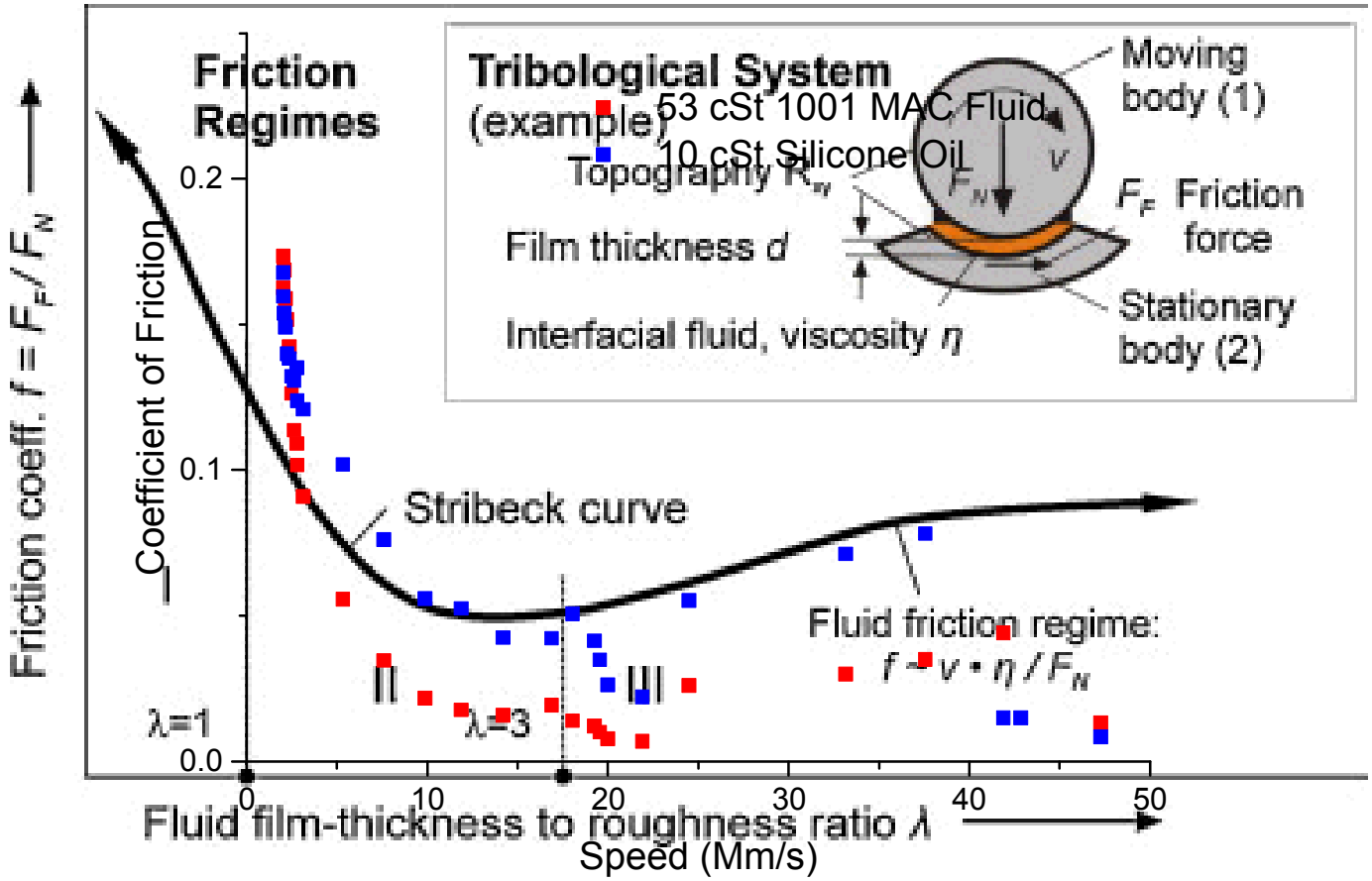


Commercial Tribometer + ECR



Allows direct measurement of electrical contact resistance while conducting friction experiments

Tribometer Into Viscometer



Allows direct measurement of impact of lubricant viscosity on friction behavior.

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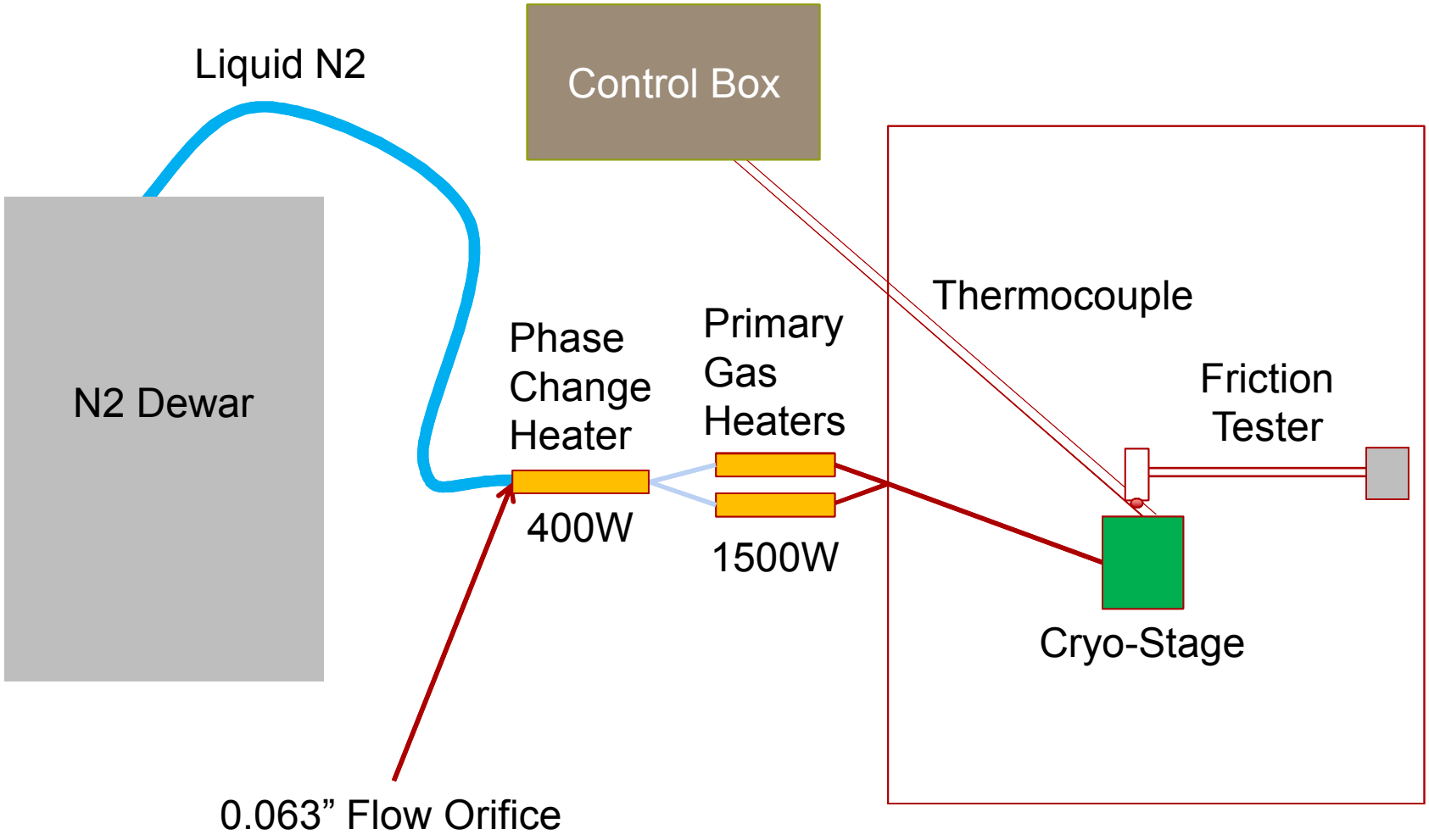
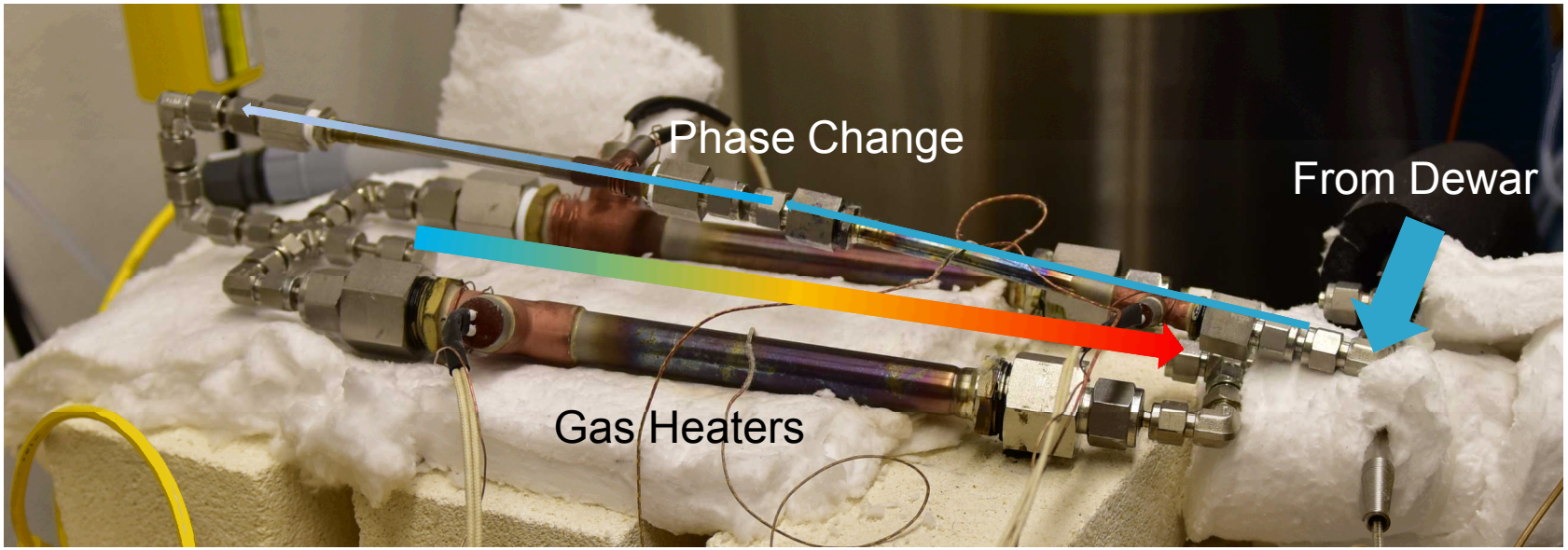
Cryogenic Friction Testing

Temperature Control



Temperature Range is -196°C to 200°C with ±1.0°C Control

Temperature Control



Safety Thermocouple

Cryo-Friction Tester

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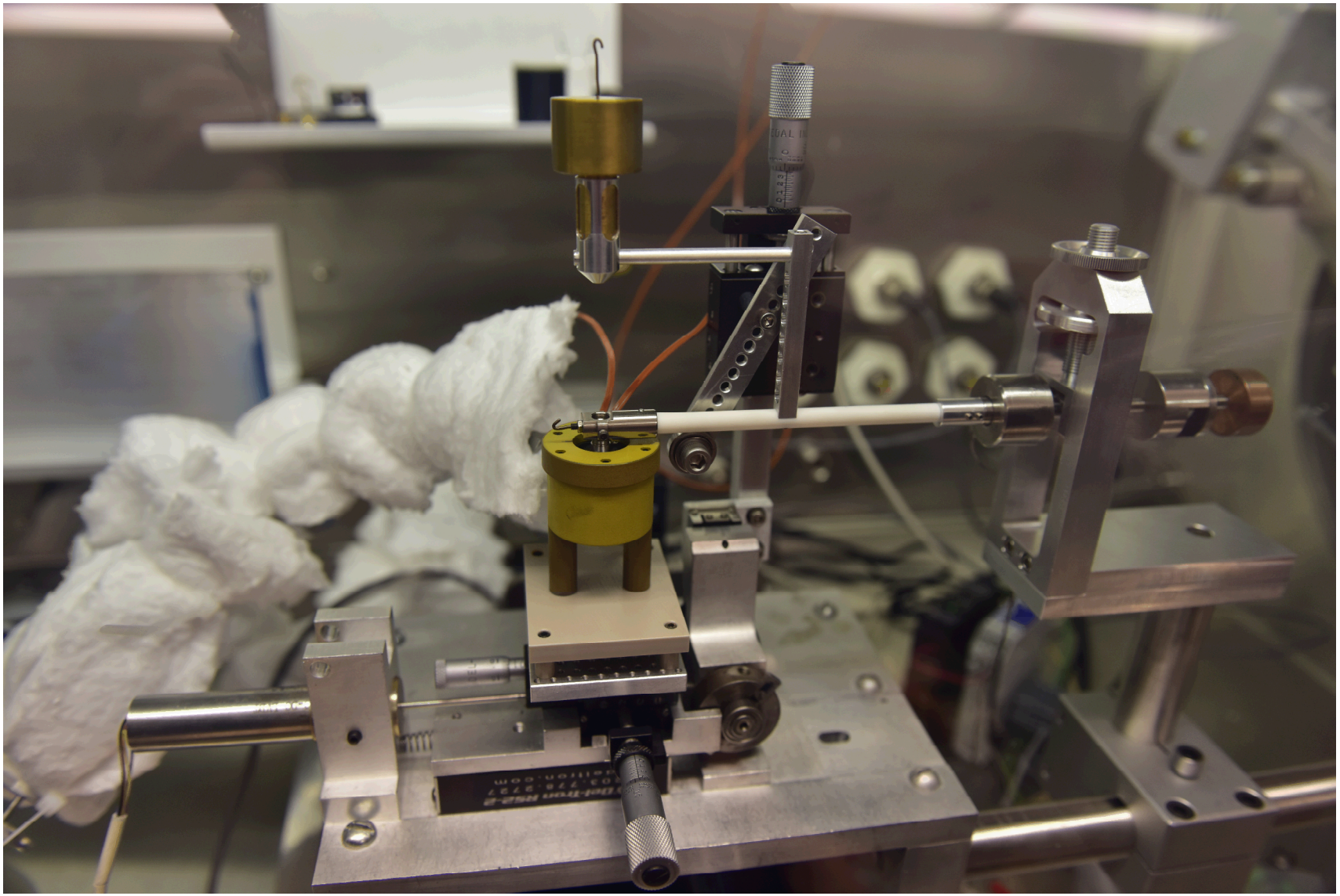
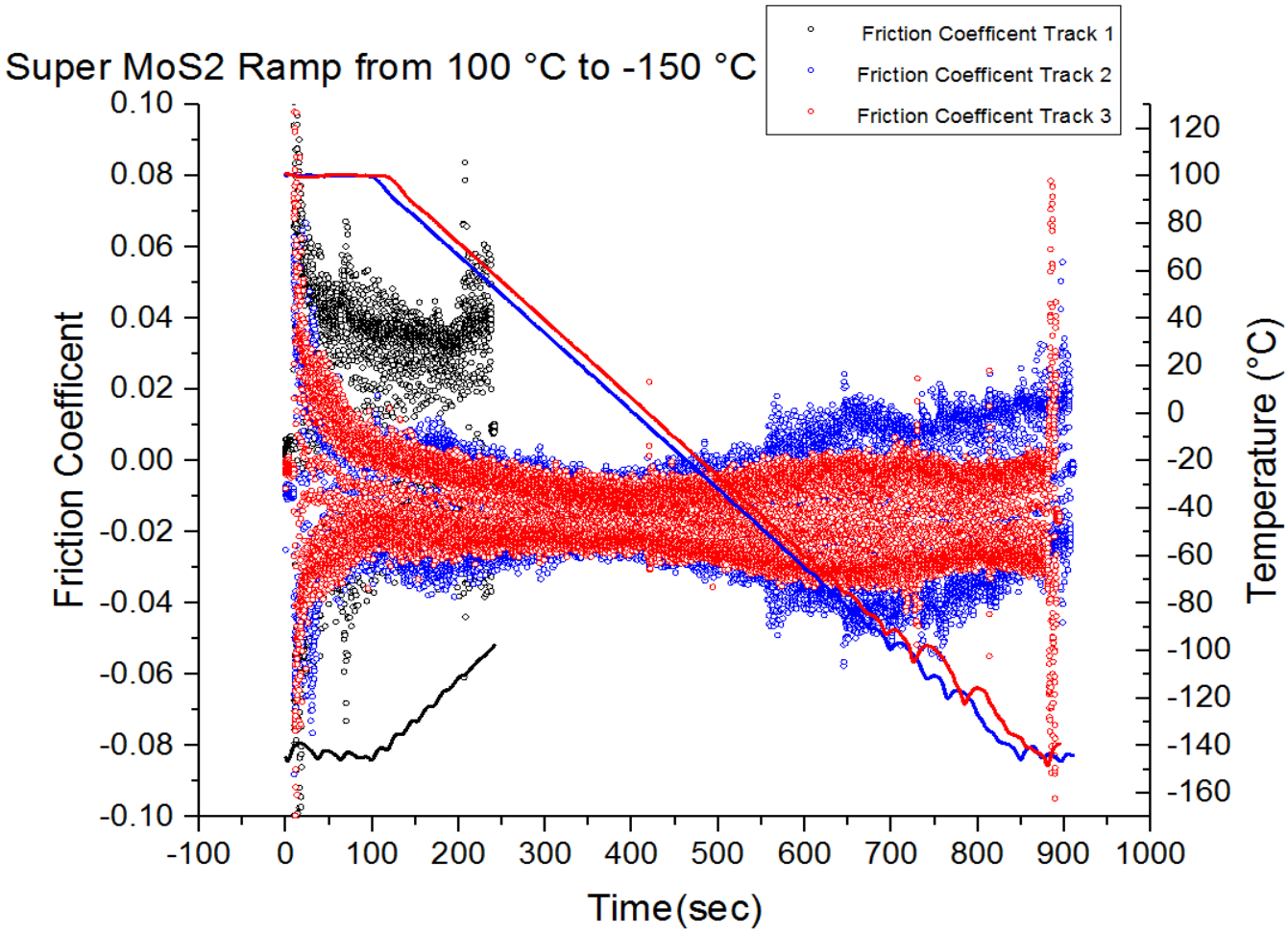


Cryo-Friction Results



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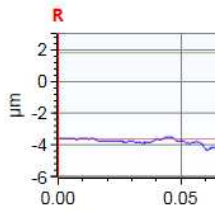
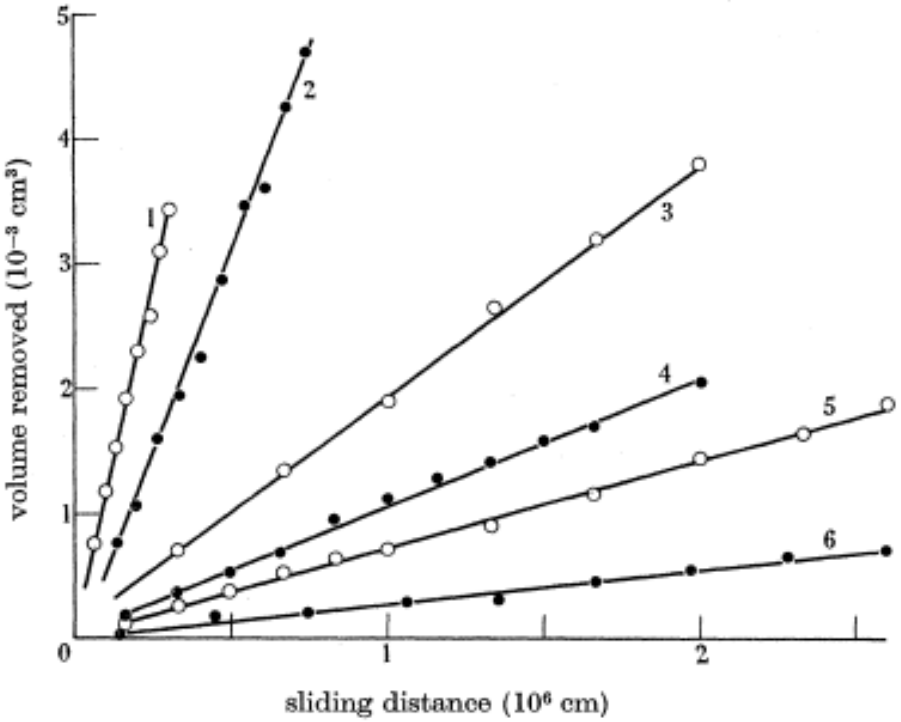
In-Situ Wear Measurement

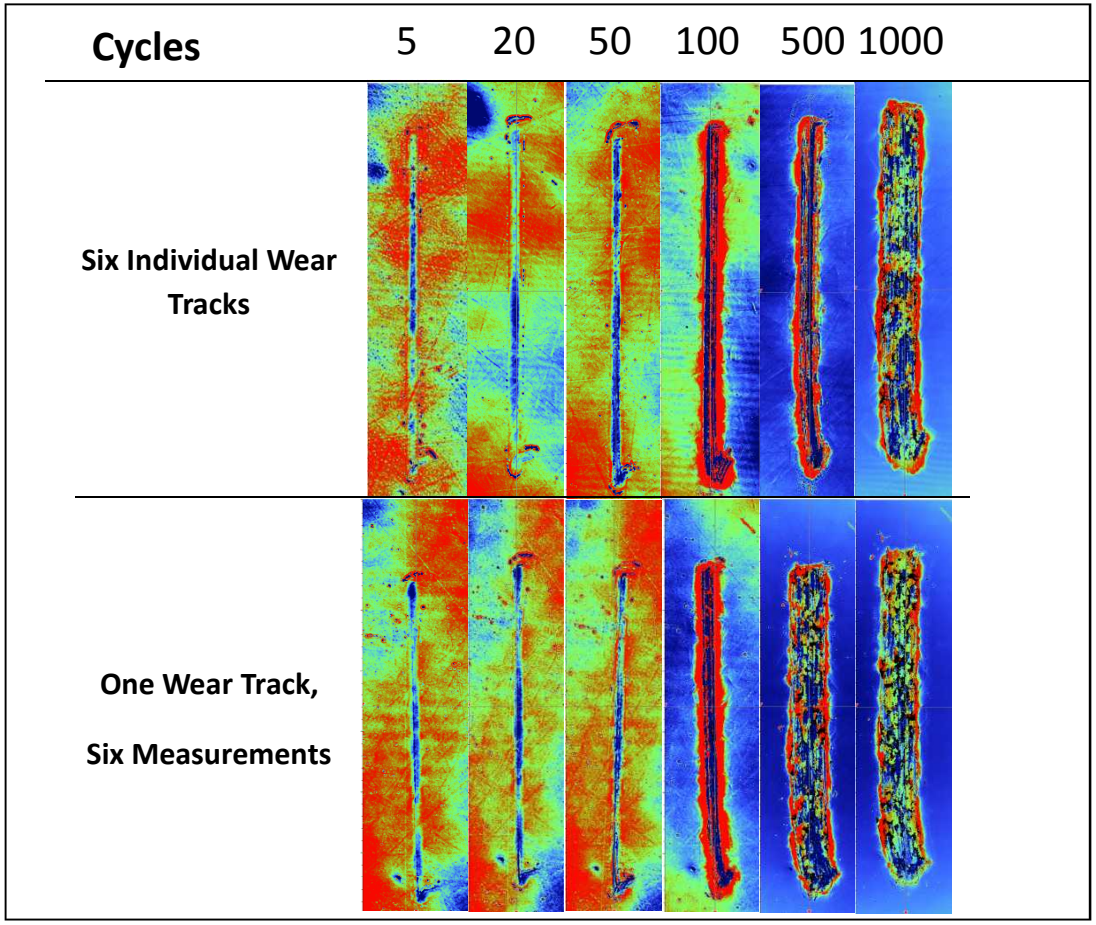
Interferometric Wear Measurement





The Wear of Metals under Unlubricated Conditions
J. F. Archard and W. Hirst
Proceedings of the Royal Society of London. Series A, Mathematical and Physical Sciences
Vol. 236, No. 1206 (Aug. 2, 1956) , pp. 397-410 Published by: The Royal Society
Stable URL: http://www.jstor.org/stable/99967

Ex-Situ Wear Measurement



Test Conditions:
50g Normal Load
1mm track
1mm/second traverse rate
Open Air Environment
2-1000 cycles
1/8” Silicon Nitride Ball
304L Flat Mirror Polished

Tribometer Layout (Linear Mode)

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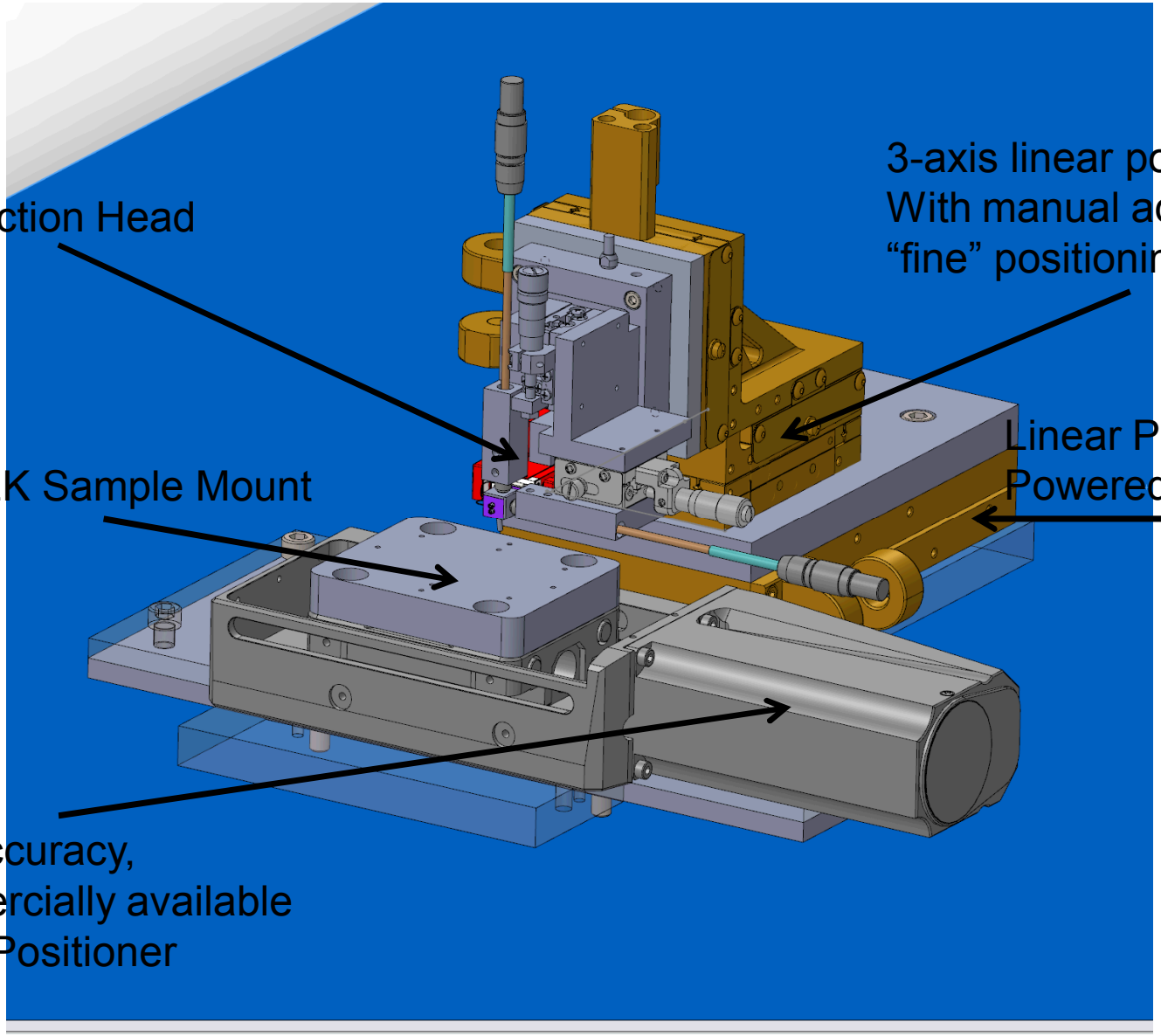
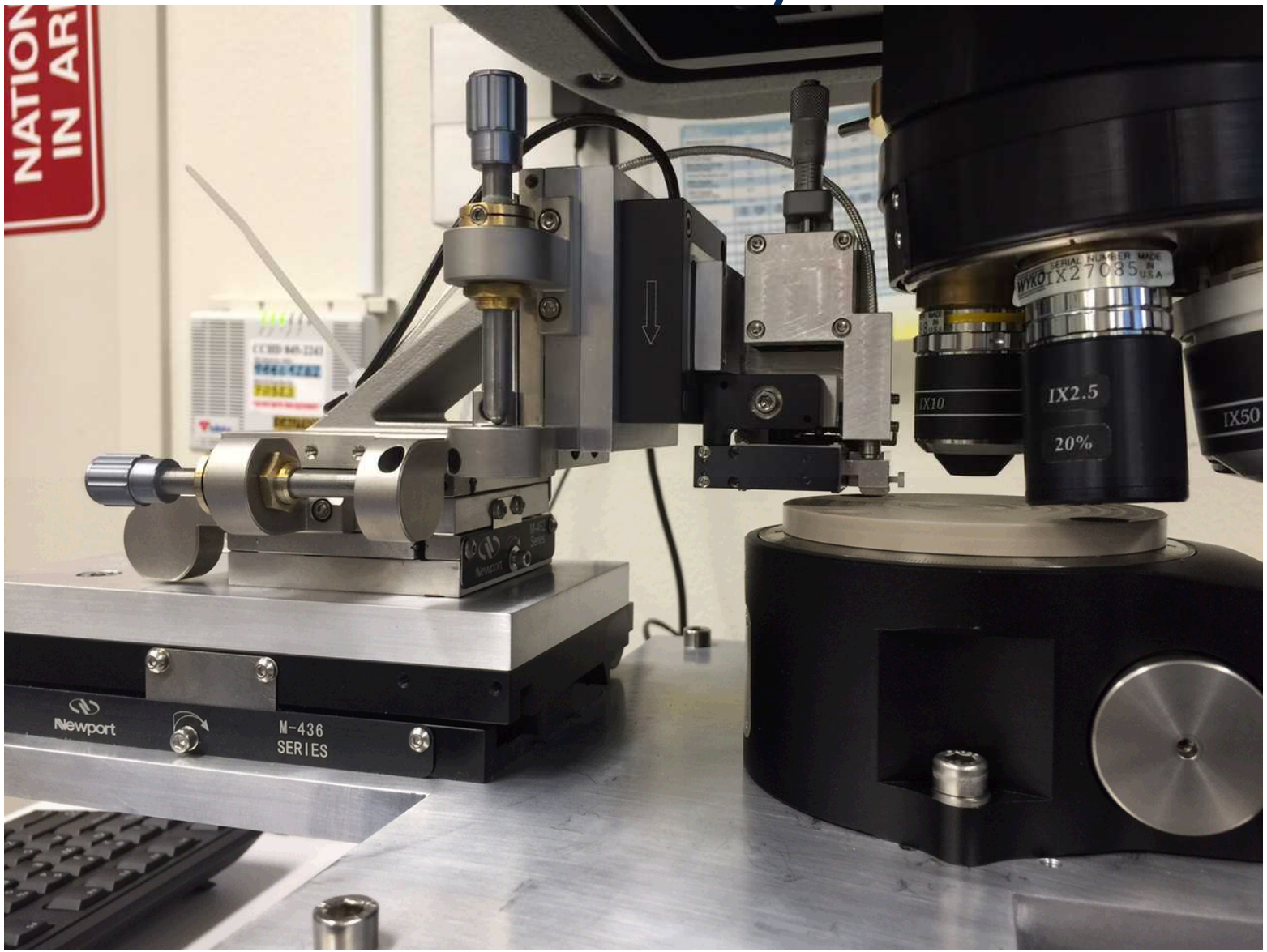


SWLI-Tribometer Rotary Mode



Future Work

- Raman Spectrometer + Friction Tester
- In-Situ Wear Scar Measurement (High Mag)
- High Temperature Cover Gas Stage

Appendix1- Cryo-Friction Tester

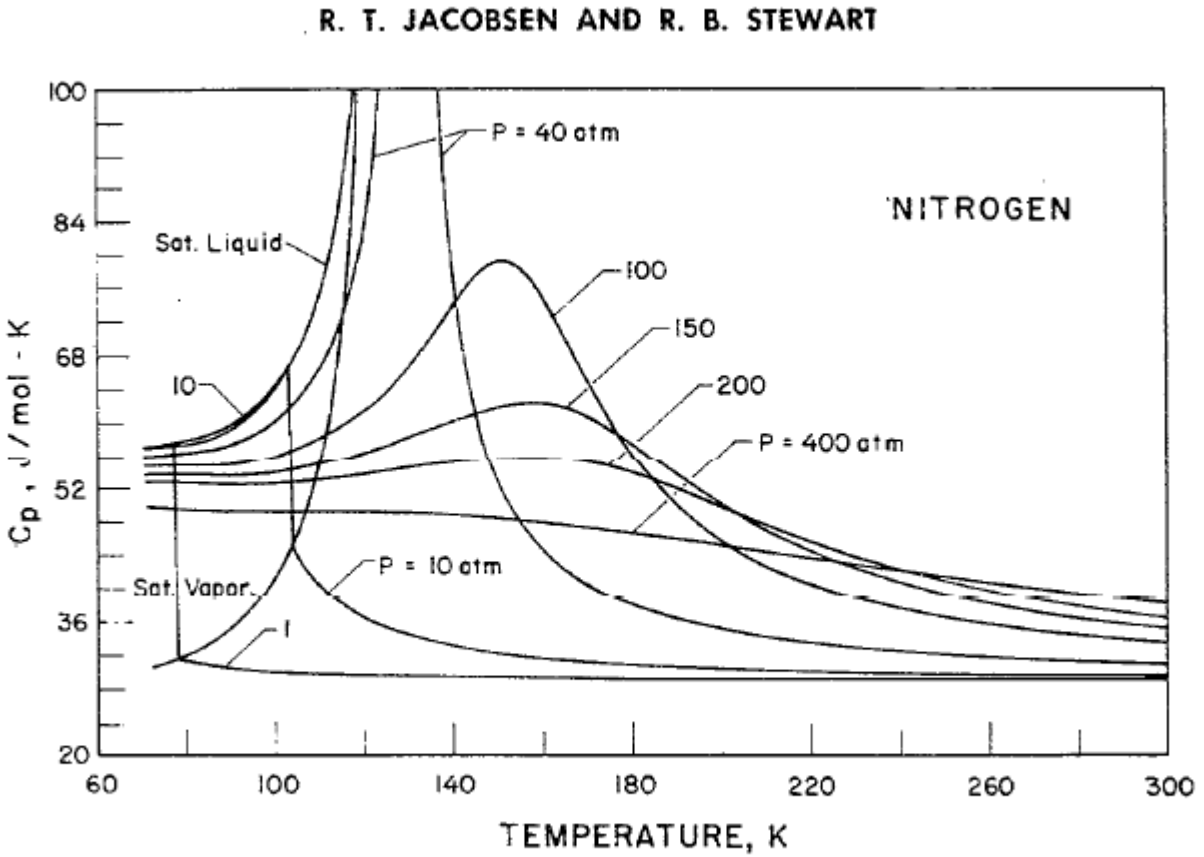


FIGURE 13. Constant pressure heat capacity (C_p) of nitrogen calculated from equation of state (6) with coefficients of table 3.