Measuring Friction at a Single Interface with Two Independent Microtribometers: A Model Study with Alumina Spheres on Gold or Single-Crystal MoS₂

**CATEGORY OR KEYWORDS:** Surfaces and Interfaces

B.P. Borovsky¹, N.T. Garabedian², G.R. McAndrews¹, R.J. Wieser¹, D.L. Burris²*

¹Department of Physics  ²Department of Mechanical Engineering
St. Olaf College       University of Delaware
Northfield, MN         Newark, DE

Fundamental studies of micro/nanoscale friction often employ scanning probes operating at relatively low speeds (< 1 mm/s). These approaches typically rely on compliant spring-based mechanisms whose deflections are sensed electrically or optically. Over the last decade, several groups have developed an alternative approach using quartz crystal microbalances (QCM) to quantify frictional forces at solid-on-solid contacts [1-4]. QCM-based techniques achieve high sliding speeds (~1 m/s) that are relevant to most practical devices. By reciprocating a probe-on-flat interface at MHz frequencies, the QCM detects lateral forces in a regime where the probe can be considered infinitely rigid. We have integrated spring-based and QCM-based measurements into a single system in order to perform well-controlled comparisons of these two distinct techniques. The interfaces examined use two model materials, polycrystalline gold and single-crystal MoS₂, against alumina microspheres. The alumina-gold tribosystem produced kinetic friction coefficients of 0.28 ± 0.03 and 0.25 ± 0.01 during QCM (~0.5 m/s) and spring-based (~25 µm/s) measurements, respectively. The alumina-MoS₂ tribosystem produced kinetic friction coefficients of 0.086 ± 0.009 and 0.041 ± 0.001 during QCM and spring-based measurements, respectively. We show how integrating these complementary approaches can help bridge the gap between fundamental and practical micro/nanotribology studies.

**REFERENCES**