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PREFACE

Progress in Tribology Through Integrated Simulations and Experiments

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Understanding and then predicting interfacial phenomena is much easier said than done. A significant challenge is that progress in tribology invariably requires the use of both experiment and theory. Experimental measurements shows trends and patterns, but often cannot directly reveal the mechanisms underlying those trends. Modeling and simulations can provide mechanistic insights, but must be validated by experiment. Unfortunately, experimental methods and numerical techniques have gained such sophistication that it is often very difficult for a single research group to be proficient at both. As a result, experimentalists and theorists often work independently, and may not even use the same terminology to describe a given phenomenon. In addition, there are often disconnects between the expectations one group has of the other. Albert Einstein described this sentiment well:

> "You make experiments and I make theories. Do you know the difference? A theory is something nobody believes, except the person who made it. An experiment is something everybody believes, except the person who made it." Albert Einstein [1]

So where does this leave us? The best solution is that theorists and experimentalists should work closely together, thereby maximizing the benefits of both approaches. Indeed, the time for such collaborations has never been better. The past few decades have seen a remarkable development in numerical techniques for simulating the properties of sliding interfaces, from atomic-scale methods such as molecular dynamics and Monte Carlo simulations to micro- and macro-scale models of dry and lubricated contact. At the same time, experimentalists have been able to make more accurate and refined measurements on well-characterized surfaces, often under ideal conditions such as ultra-high vacuum. These approaches have lead to remarkable insights into the processes occurring at the sliding interface. In addition, they are closing the gap between experiment and simulation such that model predictions and experimental measurements can, in some cases, be compared directly and quantitatively to one another. In this way, measurements can provide validation for models and the models can, in turn, offer mechanistic insights that help explain the measurements.

This issue of *Tribology Letters* highlights research teams that have been successful in experiment/theory collaboration. The authors have provided original research papers on topics including atomic-scale friction, additive chemistry, surface texturing, contact mechanics, elasto-hydrodynamic lubrication, and nano-scale wear; all of which are based on research that tightly integrates experimental measurements and numerical simulations. These are excellent examples of researchers who have overcome the hurdles of collaboration to make significant research progress. We hope that they will inspire closer collaboration between experimentalists and theorists within our tribology community leading to major breakthroughs in understanding and predictive capabilities going forward.

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Reference

1. Holton, G.: The Advancement of Science, and Its Burdens. p. 13, Cambridge University Press, Cambridge (1986) (As related by Herman F. Mark to the author)