2026 STLE Annual Meeting Tribology of Biomaterials Track Information

Tuesday, May 19, 2026

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Tribology of Biomaterials I

Session Chair: Santiago Lazarte, Chemical and Biomedical Engineering, Florida State University, Tallahassee, FL; Emily Lambeth, Biomedical Engineering, University of Delaware, Newark, DE

2:00 - 2:20 pm
4399235: Criteria for Alternate Orthopedic Bearing Materials Based on Tribology of UHMWPE
Anurag Roy, Bucknell University, Lewisburg, PA; Lisa Pruitt, UC Berkeley, Berkeley, CA

Ultra-high molecular weight polyethylene (UHMWPE) has been the gold standard for bearings in total joint replacements (TJRs) since the 1960s owing to an array of attributes such as wear resistance, chemical inertness, energetic toughness, friction, and biocompatibility. This polymer bearing articulates against a counter-bearing composed of CoCr, zirconia, alumina or Oxinium. However, UHMWPE experiences a volley of challenges in-vivo encompassing wear, fatigue, and oxidation. In recent years, researchers have attempted to find replacements for UHMWPE, such as PEEK, to surmount the aforementioned challenges but with limited success. The aim of this work is to comprehensively examine the tribological performance of UHMWPE used in TJRs, so as to formulate the criteria for alternate bearing materials which need to be at par with or better than UHMWPE. Topics such as tribological couplings, coatings, surface functionalization, parametric analysis as well as lubrication are also discussed.

2:20 - 2:40 pm
4425919: Laser Based Surface Engineering of Freeform Knee Implants for Enhanced Tribocorrosion Resistance
Vidyasagar K E Ch, Osmania University, Hyderabad, Telanaga, India

Knee implants with freeform surfaces are difficult to texture uniformly due to their complex geometry. This study presents a laser-based surface engineering approach to improve the tribocorrosion performance of SS316L femoral knee implants. A Stewart platform enabled precise multi-axis control to apply dot-pattern micro-dimples (35–40 µm wide, 15–20 µm deep) across the implant surface. CAD-based trajectory planning ensured accurate and consistent laser focus. Corrosion behavior was

evaluated in simulated body fluid following ASTM G5-14. Textured implants showed improved performance, with corrosion potential increasing from −477 mV to −361 mV and current density decreasing from 7.396 μA to 6.103 μA. Corrosion rate dropped by 30%. Tribological tests confirmed a reduction in average friction coefficient. Surface scans showed fewer scratches and reduced wear. Laser texturing offers a precise and effective way to enhance implant durability without altering base material properties.

2:40 - 3:00 pm
4435797: Laser-Textured CoCrMo Surfaces with Sub-10 μm Dimples for Improved Hip Joint Tribology
Will Bennett, Min Zou, University of Arkansas, Fayetteville, AR

Laser surface texturing was applied to CoCrMo alloys to evaluate how micro-dimple geometry influences friction and wear when sliding against vitamin E–stabilized UHMWPE under simulated joint conditions. Arrays of 5 μm dimples with varying aspect ratios (0.1–0.3) and surface densities (5–25%) were produced by femtosecond laser ablation and tested using pin-on-disc tribometry in bovine serum at 37 °C. Textured surfaces consistently showed lower and more stable coefficients of friction than untextured controls, with the best performance achieved at 5% surface density and 0.1 aspect ratio. Enhanced wettability promoted lubricant film stability, while excessive texture density introduced wear-inducing protrusions. The results demonstrate that precise micro-texturing can significantly extend the lifetime of metal-on-polyethylene bearing pairs by improving lubrication efficiency and mitigating material loss.

3:00 - 4:00 pm - **Exhibitor Appreciation Break**

4:00 - 4:20 pm
4401530: How Swelling Affects Microscale Creasing and Stick-slip Friction of Soft Elastomers
Md Sazzadul Alam Rahat, Jonathan Pham, University of Cincinnati, Cincinnati, OH; Rong Long, University of Colorado Boulder, Boulder, CO

Understanding tribology of soft materials is crucial for many applications, such as joint health and bioinspired adhesives. Prior research addresses friction mechanisms on soft elastomers across swelling states, from non-swollen adhesives exhibiting Schallamach waves causing stick-slip friction fluctuations, to highly swollen hydrogels where these instabilities are suppressed. However, microscale interfacial mechanics across swelling remains unclear. This study uses confocal microscopy and colloidal probe lateral force microscopy to examine friction between glass microspheres and swollen elastomers. Results show stick-slip persists in moderately swollen states but is suppressed with higher swelling, reducing average friction and stick-slip amplitude. Contact size versus lateral force analysis reveals a transition in stick-slip behavior between static and kinetic friction, smoothing with swelling. These findings advance understanding of microscale friction on soft swollen elastomers.

4:20 - 4:20 pm
4432420: Frictionally Enhanced and Biologically Activated Artificial Ligament via a Carrot-and-Stick and Microphase-Separation Strategy
Shenglin Li, Chao Zhang, Jian Song, Sun Yat-sen University, Shenzhen, Guangdong, China; Yuhong Liu, The State Key Laboratory of Tribology, Beijing, Beijing, China

In this study, a "carrot-and-stick" reinforcement strategy and a microphase-separated activation layer strategy were developed to address the poor wear resistance, creep resistance, and lack of bioactivity in braided polyethylene glycol terephthalate (PET) artificial ligaments. In the "carrot-and-stick" reinforcement strategy, wear-resistant PET monofilaments were incorporated with flexible multifilaments

to fabricate novel textures with enhanced ultimate tensile strength, improved creep resistance, and reduced coefficient of friction. For bioactivation, a dimethyl sulfoxide (DMSO)-water-polyvinyl alcohol (PVA) ternary system was used to form a microphase-separated PVA activation layer on PET fibers, promoting not only creep resistance but also bone marrow mesenchymal stem cell adhesion. In conclusion, the "carrot-and-stick" and microphase-separation strategy are simple and cost-effective strategies show promise in enhancing the clinical performance of PET ligaments.