TAIHO KOGYO TRIBOLOGY RESEARCH FOUNDATION
2-47 Hosoya-cho, Toyota-city, Aichi Pref., 471-8502 Japan Phone +81- 565 -28-9284 Fax +81- 565 -28-9298
TTRF

9th TTRF-TAIHO International Symposium on Automotive Tribology 2026

1. Date ： Tuesday, April 14, 2026 10:00 - 17:00(JST) <Reception 17:30-19:00>
2. Venue: 2F, Large Hall, WINC AICHI, 4-4-38 Meieki, Nakamura-ku, Nagoya, Aichi, Japan
3. Theme: Tribological Design Technique Improves Powertrains Performance
4. Program:

< Opening >	Moderator Toru Desaki	
10:05-10:10	Opening Address	Toshio Niimi Organizing Committee Chair (Taiho Kogyo Co., Ltd.)
< Honorary Lecture >		Chair Ali Erdemir (Texas A&M University)
10:10-11:00	Honorary Lecture 1: Toyota's Multi-Faceted Approach to Decarbonization and the Future of Next-Generation Powertrains	Masataka Miyazaki (Toyota Motor Corporation)
11:00-11:50	Honorary Lecture 2: Tribology for Automotive Decarbonization and Circular Economy: Surface Engineering and Emerging Challenges in the Electrified Mobility Era	Shinya Sasaki (Tokyo University of Science)
11:50-13:00	<Lunch>	
< Session 1 >	Design of Components for Higher Performance (Part 1)	Chair Yorimasa Tsubota (Isuzu Motors Limited)
13:00-13:30	Lecture 1: Modeling of Traction Drive and Traction Coefficient Enhancement Using Surface Texture Under High-Speed Conditions	Takeshi Yamamoto (Tokai University)
13:30-14:00	Lecture 2: CFD Simulation of Transmission Fluid Flow	Thomas Lohner (Technical University of Munich)
14:00-14:30	Lecture 3: Friction Prediction Method for Engine Bearings using EHD Analysis Considering Modified Friction Coefficient and Running-in depending on Lubrication Conditions	Yohei Kurabe (Taiho Kogyo Co., Ltd.)
14:30-14:45	General Discussion	
14:45-15:10	<Break>	
< Session 2 >	Design of Components for Higher Performance (Part 2)	Chair Kazuyuki Yagi (Kyushu University)
15:10-15:40	Lecture 4: Laser Surface Texturing and Laser Induced Periodic Surface Structures for Tribology Applications in Industry	Tuğrul Özel (Rutgers University) *TTRF Grant Awardee
15:40-16:10	Lecture 5: Recent Developments in Surface-Textured Technologies for High-Speed Mechanical Seals in e-Motor Shaft Applications	Yuichiro Tokunaga (Eagle Industry Co., Ltd.)
16:10-16:40	Lecture 6: Coatings for Metallic Bipolar Plates for Proton Exchange Membrane (PEM) Fuel Cell - The Design Pyramid of Coating Development and Industrialization	Thomas Stoecker (Schaeffler Technologies AG & Co. KG)
16:40-16:55	General Discussion	
< Closing >	Moderator Toru Desaki	
16:55-17:00	Closing Address	Tomohiro Kano (Taiho Kogyo Co., Ltd.)

5. Reception: 17:30-19:00(JST) 6F Exhibition Hall

6. Abstract

Honorary Lecture 1	Toyota's Multi-Faceted Approach to Decarbonization and the Future of Next-Generation Powertrains	Masataka Miyazaki (Toyota Motor Corporation)

Toyota is committed to global decarbonization through a multi-pathway strategy that combines diverse technologies and fuels.
In this presentation, we will introduce trends in next-generation powertrains such as internal combustion engines (ICE), battery electric vehicles (BEV), and fuel cell electric vehicles (FCEV), along with the energy circumstances specific to each region.
We explain initiatives to reduce CO_2 emissions and primary energy consumption through the effective use and recycling of scarce resources.
The importance of tribology technologies that reduce friction and wear is increasingly recognized in achieving further improvements in Powertrain efficiency and durability.
Toyota aims to realize a sustainable mobility society by integrating internal combustion engines with electrification technologies.

Honorary Lecture 2	Tribology for Automotive Decarbonization and Circular Economy: Surface Engineering and Emerging Challenges in the Electrified Mobility Era	Shinya Sasaki (Tokyo University of Science)

Achieving carbon neutrality in the automotive sector is a critical global challenge in the fight against climate change. Beyond vehicle electrification, further decarbonization requires comprehensive reductions in energy losses, resource consumption, and environmental impact throughout the entire life cycle of automotive components. In this respect, tribology plays a central role by enabling friction reduction, wear control, and lifetime extension, which are essential for both energy efficiency and the realization of a circular economy.

This lecture introduces recent advances in tribological technologies that contribute to automotive decarbonization, with a particular focus on advanced surface engineering approaches, including surface texturing and tribo-film formation controlled by lubricant additives. These technologies not only reduce frictional losses but also promote component durability, remanufacturing, and reuse, thereby supporting circular material flows.

Furthermore, the rapid transition to electric vehicles (EVs) presents new tribological challenges arising from high-speed operation, unique loading conditions, electrical effects, and altered lubrication environments in electrified powertrains. The lecture reviews current research trends addressing these issues, such as in-situ tribological diagnostics, data-driven design, and AI-assisted tribology. Finally, future perspectives are discussed, highlighting how integrated tribological solutions can simultaneously support decarbonization, circular economy principles, and sustainable mobility.

< Session 1 > Design of Components for Higher Performance (Part 1)

Lecture 1	Modeling of Traction Drive and Traction Coefficient Enhancement Using Surface Texture Under High-Speed Conditions	Takeshi Yamamoto (Tokai University)

A high-speed electric motor with a small reducer that has high-power transmission efficiency can be used to realize a high-power-density powertrain system because electric motors can be miniaturized to increase the rotational speed. A traction drive has low vibration noise due to its lack of meshing vibration, making it suitable as a transmission element for high-speed reducers. However, the traction coefficient, which greatly affects transmission performance, decreases with increasing rotational speed. In this study, to increase the traction coefficient using a surface texture, a model that takes into account transient temperature changes under high-speed conditions and the effects of micro-surface geometry was developed. The traction coefficient was measured using a high-speed test machine capable of operating at a maximum speed of 50,000 rpm. The model was able to predict the experimental values with an error of at most 6%. The high-pressure rheological properties of the oil were examined to develop design guidelines for the surface texture and a model was used to optimize the texture parameters. The designed texture was manufactured and evaluated. Experimental results show that the traction coefficient can be improved by up to 19%.

Lecture 2	CFD Simulation of Transmission Fluid Flow	Thomas Lohner (Technical University of Munich)

Efficiency, heat management and durability are important factors in the development and design of sustainable and high-performance electric drive units. Fluid lubrication of transmissions is required in order to reduce friction and wear and to remove frictional heat. The fluid flow in geared transmissions (in short: gearboxes) is determined by the kinematics of the machine elements and how they interact with the fluid, typically oil and air. Computational fluid dynamics (CFD) is now used as a design technology to understand the gearbox fluid flow, evaluate the main flow paths and lubricant supply rates to machine elements, and quantify load-independent power loss and convective heat transfer. Based on this, the design of the gearbox and housing, as well as the lubricant supply rates, can be optimized to minimize power loss and ensure sufficient thermal load capacity. This presentation will introduce the main types of gear-fluid interaction, mesh-based and meshless numerical simulation methods, and experimental methods to validate simulation models. Case studies on single-stage gearboxes showing the influence of various parameters such as viscosity, gear parameters and operating parameters will be presented, as well as case studies on an electric drivetrain and an axle drive gearbox. The presentation will conclude with a framework demonstrating how to incorporate simulated load-independent power loss and heat transfer coefficients into efficiency and heat balance modeling.

Lecture 3	Friction Prediction Method for Engine Bearings using EHD Analysis Considering Modified Friction Coefficient and Running-in depending on Lubrication Conditions	Yohei Kurabe (Taiho Kogyo Co.,Ltd.)

Friction reduction is an effective approach to improve the thermal efficiency of internal combustion engines, and accurate prediction of bearing friction is essential for model-based development. However, under mixed lubrication conditions, friction prediction still involves uncertainty due to solid contact behavior and the running-in process. In this study, a friction prediction method for journal bearings is developed by incorporating a modified friction coefficient model and a running-in simulation into a coupled multi-body dynamics and elastohydrodynamic (EHD) analysis. The modified friction coefficient, which depends on lubrication conditions, is formulated as a function of the lubrication number and identified for aluminum alloy bearings and solid-lubricant overlay bearings using mixed-lubrication rig tests. Running-in progression is modeled by updating surface roughness parameters through macro- and micro-scale wear calculations. The proposed model is applied to engine firing conditions, and the predicted bearing friction torque is compared with experimental results obtained from indicated mean effective pressure measurements. Furthermore, friction reduction effects of solid-lubricant overlay bearings are evaluated by replacing bearing materials and comparing calculated and measured differences. The results show that the proposed model reproduces the measured friction reduction trends with good agreement over a wide range of engine speeds. These findings demonstrate that considering lubrication-dependent solid contact friction and running-in behavior significantly improves the reliability of friction prediction for engine journal bearings.

< Session 2 > Design of Components for Higher Performance (Part 2)

Lecture 4	Laser Surface Texturing and Laser Induced Periodic Surface Structures for Tribology Applications in Industry	Tuğrul Özel (Rutgers University)

Laser surface texturing (LST) and laser-induced periodic surface structures (LIPSS) have emerged as powerful, contact-free techniques for tailoring surface functionality in tribology-critical components. This lecture provides an overview of the fundamental laser–matter interaction mechanisms that govern micro- and nanoscale surface structuring, with emphasis on how controlled surface topography and morphology influence friction, wear, and lubrication regimes. The formation principles of deterministic textures and self-organized LIPSS are introduced, highlighting the roles of laser wavelength, pulse duration, fluence, polarization, and scanning strategy.

The lecture further discusses how laser-generated textures and periodic nanostructures modify real contact area, debris entrapment, lubricant retention, and interfacial energy, leading to measurable improvements in friction reduction, wear resistance, and lifetime of tribological pairs. Industrially relevant case studies are presented from automotive, tooling, biomedical, and energy sectors, demonstrating performance gains under dry, boundary-lubricated, and mixed-lubrication conditions.

Finally, the lecture addresses scalability, process repeatability, and integration of LST and LIPSS into manufacturing workflows, including challenges related to throughput, surface integrity, and quality control. The talk concludes with an outlook on data-driven optimization and hybrid laser texturing strategies for next-generation tribological surfaces in industrial applications.

Lecture 5	Recent Developments in Surface-Textured Technologies for High-Speed Mechanical Seals in e-Motor Shaft Applications	Yuichiro Tokunaga (Eagle Industry Co., Ltd.)

Electric motors with high power density increasingly require shaft-cooling systems and higher rotational speeds to achieve greater efficiency. Under these demanding conditions, mechanical seals must provide both low friction and high durability. Surface-textured sealing technology offers a practical solution by enabling microscopic flow control on the sealing faces, resulting in negligible leakage and up to 90% lower friction compared with conventional non-textured seals.

This presentation introduces the development of an ultra-low-friction, low-leakage mechanical seal specifically designed for high-speed e-motor shafts. Application examples, including e-motor shaft-cooling systems and reduction gearboxes, will be presented to demonstrate how this technology contributes to improved performance and reliability in next-generation electric drive units.

Lecture 6	Coatings for Metallic Bipolar Plates for Proton Exchange Membrane (PEM) Fuel Cell - The Design Pyramid of Coating Development and Industrialization	Thomas Stoecker (Schaeffler Technologies AG & Co. KG)

Coatings have contributed to significant performance improvements in mobile powertrains in many ways, e.g., by reducing friction, extending service life through wear protection, and increasing corrosion resistance. Coatings will also play a crucial role in future powertrains. They are the key element in the industrialization of proton exchange membrane (PEM) fuel cells. The fulfillment of specified properties plays a decisive role in achieving scaling and industrialization.

The verification of these properties and the performance of characterization vary greatly in research and development compared to industrialization. While R&D focuses purely on proving that the specified properties have been achieved, industrialization and subsequent series production must ensure that the specified properties are realized in robust coating processes while maintaining quality characteristics.

The presentation highlights the role of coating design and coating property characterization in R&D on the one hand and industrialization on the other. Not only are the characterization methods used presented as examples, but insight is also provided into the methodological approach, such as the Production Part Approval Process (PPAP) or the determination of process capability.