Contents:
Special Issue on Tribochemistry and Tribometry

Guest Editors: Mathias Woydt, Simon Tung, and George Totten

iii Overview

GENERATION FROM LUBRICANTS

191 ZDDP Containing Tribofilms Generated under Sliding Micro Contact and Bearing Test Rig Conditions—Florian Pape, Christian Muhmann, Dieter Lipinsky, Heinrich F. Arlinghaus, and Gerhard Poll

213 Generation of Defined Tribofilms and Their Stability under Slip-Rolling in a 2Disk Test Rig—Mathias Woydt, John-Theodore Burbank, and Dirk Spaltmann

MATERIALS ASPECTS


252 The Influence of Boronizing Temperature on Microstructure and Wear Resistance in Low-Carbon Steels—Undrakh Mishigdorzhiyn and Igor Sizov

266 Electrochemical Characterization of a Nickel-Phosphorus Coating on Diamond Grits—Lian Ma, XiHua He, Alex Fang, and Hong Liang

(Contents continued on back cover)
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The journal publishes high-quality, original articles, including full papers, review papers, and technical notes, on both theoretical and practical aspects of the processing, structure, properties, and performance of materials used in mechanical, transportation, aerospace, energy systems, and medical devices. These materials include metals and alloys, glass and ceramics, polymers, composite materials, textiles, and nanomaterials. The journal covers topics related to the integrity of materials which encompasses mechanical testing, fatigue and fracture, corrosion, wear, and erosion, as well as the integrity of components and systems such as rolling element bearings, piping and pressure vessels, fasteners, space technology, and nanotechnology. The journal publishes articles on both qualitative and quantitative methods used to characterize materials including all forms of microscopy, chemical analysis, and nondestructive evaluation.

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Overview

Special Issue on Tribochemistry and Tribometry

This Materials Performance and Characterization Special Issue on Tribochemistry and Tribometry includes thirteen papers with the related topics:

- Materials impact
- Generation from lubricants
- Tribometry

These papers give an introduction to the complexity of interacting surfaces (materials) with lubricants, either additives and/or base oils, and how tribometry evolved to disclose these interactions. The whole tribosystems must be considered, which are composed of two triboelements, the lubricant interface and the surface boundaries.

Tribometry focuses so far on functional properties—like coefficients of friction, wear, and extreme pressure—because these appear in specifications. Several new testing methodologies illuminated in this special issue describe how to generate tribofilms, which determine the functional properties. The generation of tribofilms is seen as a tool to understand the functional mechanisms of additives interacting between each other when forming a triofilm. In order to better understand the “functioning” of the micro-asperities, other quantities are needed. The common (average) friction signal must be combined with contact resistance, acoustic emissions, high resolution friction signal analysis, stroke, etc. These uncommon quantities also enable one to identify the beginning of adhesive failure before it can be seen macroscopically.

Lubricants and additives are tribotested against carbon steels, gears, and ball bearing steels. In reality, the range in alloys is extremely wide, varying by region and from OEM. In consequence, it is important to study and evaluate the tribological response of additives and formulations in respect to a variety of alloys and thin films. For engine efficiency improvement, various approaches include improvements in advanced combustion systems, component system design and handling—such as down-sizing, boosting, and electrification—as well as waste heat recovery systems etc. In this special publication, the fundamentals of tribometry specific to the environments of engine components tribology have been reviewed, together with discussions on the impact of developing vehicle powertrain technologies, surface and material technologies, as well as lubricant and additive technologies on promises of continuing friction and wear reduction trends.

Significant advances have been made in recent years in material development and surface engineering applied to engine components. Light-weight non-ferrous alloy and nano-composites are being incorporated that include a wide range of materials such as thermal sprayed aluminum liners, diamond-like carbon (DLC) coated piston rings, DLC coated roller bearing, and hard nitride coatings for valve train and gear components in gasoline and diesel engines. Both chemical vapor deposited and physical vapor deposited diamond-like coatings begin to find promising applications to engine parts. Carbon film types—from diamond-like carbon to tetrahedral carbon (ta-C) with different sp²/sp³-hybridisation ratios and hydrogen contents—have to be mentioned. Optional, uncoated alternative steel metallurgies, which can be novel in
automotive industries and available on an industrial base, intrinsically reduce friction and enter into focus.
The available piston ring/cylinder liners metallurgies, including types of coatings, are spiraling.

It has to be noted as essential that base fluids blended with high-performance additive packages lubricate
a reliable manifold of different metals in a wide range of operating conditions. These balanced and perform-
ing technologies are questioned by:

- Eco-toxicological legislations,
- Stronger fuel economy targets in combinations with a variety of “biofuels”,
- Downsizing and lightweight approaches that increase Hertzian contact pressures and PV values,
- In parallel, spiraling number of tests for specifications with a shorter lifetime associated with a
  regional fragmentation,
- Prohibition of well known and performing chemicals and materials for toxicological reasons (“sunset
  dates”) calling for substitutions, and
- Required time and cost saving tribological testing methodologies for their identification and
  qualification

Guest Editors
Mathias Woydt
Simon Tung
George Totten
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IN APPRECIATION

The high quality of the papers that appear in this publication is a tribute not only to the obvious efforts of the authors represented but to the unheralded, though essential, efforts of their reviewers. It is to the reviewers dedication to upholding the high standards of their profession that this note pays tribute. On behalf of ASTM International and the authors as well, we acknowledge with appreciation their important contribution to the success of this journal.
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213 Generation of Defined Tribofilms and Their Stability under Slip-Rolling in a 2Disk Test Rig—Mathias Woydt, John-Theodore Burbank, and Dirk Spaltmann

226 Nanolubrication Mechanisms: Influence of Size and Concentration of CuO Nanoparticles—Salete Martins Alves, Valdicleide Silva e Mello, and Amilton Sinatara

MATERIALS ASPECTS


252 The Influence of Boronizing Temperature on Microstructure and Wear Resistance in Low-Carbon Steels—Undrakh Mishigdorzhiyn and Igor Sizov

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