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EDITORIAL

Guest editorial: Special issue on 6th World Tribology Congress

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The 6th World Tribology Congress (WTC 2017), hosted by Chinese Tribology Institute (CTI) and organized by the State Key Laboratory of Tribology (SKLT) of Tsinghua University, will be held in Beijing, China, on September 17–22, 2017. The objective of the congress is to highlight recent important progress in tribology and to strengthen the links between academia and industry. More than 900 oral presentations and over 300 posters have been accepted in 9 tracks, 170 oral sessions and 2 poster sessions. The exhibition and networking on WTC 2017 are designed to broaden knowledge and provide a range of perspectives on tribology. A technical exhibition and some visits to SKLT of Tsinghua University are also organized.

As chairman of the Organization Committee of WTC 2017 and the Editor-in-Chief of the journal *Friction*, I have invited prominent and specialized experts in tribology to contribute their works based on their plenary and keynote reports to the special issue on WTC 2017 for celebrating the grand congress. The research progresses in this special issue bridge over the fundamentals of tribology and its applications to industrial practices. This issue contains 8 invited papers to demonstrate the breadth and the timeliness of tribology and to anticipate future developments. These papers include:

- Four review articles on discussing how tribology has been helping us to advance and to survive, the properties and development status of multilayer coating systems for tribological applications, the influence of tribology on global energy consumption, costs and emissions, and the tribological behavior of sintered iron-based self-sintered and iron-based self-lubricating composites;
- Four research papers on the influence of contact geometry and material gradients on the strength of adhesive contacts, the comparison of stick and slip contact conditions for a coated sphere compressed by a rigid flat, the combined effect of surface microgeometry and adhesion in normal and sliding contacts of elastic bodies, and the design and application of friction pair surface modification coating for remanufacturing.

The first paper, by Gwidon W. Stachowiak, reviews the contribution and the importance of tribology in industry and society. This paper provides a good overview of how tribology has been effectively applied in various industries to advance the quality of our lives, e.g., by reducing energy consumption and managing pollution or contamination of the environment. Further, the author forecasts that new challenges such as sustainability, climate change, and gradual degradation of the environment require new solutions and innovative approaches as humanity progresses.

Mahdi Khadem et al. review the properties and the development of multilayer coating systems with the aim of providing a comprehensive overview of multilayer coating for tribological applications and gaining a better understanding of their advantages and limitations. The general issues related to materials, design concepts, mechanical properties, deposition method, and friction and wear characteristics of multilayer coatings are also discussed in detail. Specifically, Ti-based and Cr-based coatings were emphasized because Ti and Cr are identified as elements used widely in many multilayer coating applications.

Kenneth Holmberg and Ali Erdemir assess the impact of friction and wear on global energy consumption, economic losses, and CO_2 emissions worldwide in the four main energy consuming sectors, namely, transportation, manufacturing, power generation and residential, by using a methodology developed by the authors in their case studies on

passenger cars, trucks and buses, paper machines, and the mining industry. They then estimate potential savings that can be gained by employing the proposed tribological solutions. This review paper provides material evidence of the significance of tribology to the general public.

Jose Daniel Biasoli de Mello et al. review the tribological behavior of sintered iron-based self-lubricating composites. The most important results obtained by an ongoing research program toward the development of innovative, low-cost, self-lubricating composites with a low friction coefficient and high mechanical strength and wear resistance are presented and discussed in detail. Special emphasis is given to uniaxial die pressing of solid lubricant particles mixed with matrix powders and to metal injection molding associated with *in situ* generation of solid lubricant particles.

Valentin L. Popov et al. present an experimental investigation and numerical simulation for contacts of rigid punches with a flat but oddly shaped face contacting a soft, adhesive counterpart. When it is carefully pulled off, they find that in contrast to circular shapes, detachment does not occur instantaneously; instead, the detachment fronts start at pointed corners and travel inward until the final configuration is reached. For elongated indenters, the final shape resembles the original one with rounded corners. Numerical simulations are performed using a new formulation of the boundary element method for simulation of adhesive contacts suggested by Pohrt and Popov. The method is extended for describing power-law gradient media. This work provides a very inspiring base for the community to extend their investigation of the influence of microcontact shapes.

A finite element analysis is used by Shai Ronen et al. to study a comparison of stick and slip contact conditions for a coated sphere compressed by a rigid flat. A comparison with the slip contact condition is presented in terms of the critical contact parameters and plasticity evolution. Empirical expressions are provided for critical interferences of the first and second yield inceptions, in the coating and on the substrate side of the interface, respectively. An expression is also provided for the dimensionless coating thickness for optimal resistance to plasticity under the stick contact condition. Additionally, the relations between different contact parameters in the elastic-plastic regime are presented.

Irina Goryacheva et al. develop an approach to investigate the combined influence of surface microgeometry and adhesion on the load–distance dependence and energy dissipation in an approach–separation cycle, as well as on the formation and rupture of adhesive bridges during friction. The energy dissipation in a cycle of approach-separation of asperities of rough surfaces is calculated. Then the adhesive component of the friction force is calculated using the energy dissipation. The Maugis-Dugdale approximation is used for modeling the adhesive interactions. A specific feature of the paper is that contrary to many other studies in the area, the mutual influence of microcontacts is taken into account by the authors.

Remanufacturing is an important method to recover the dimensional accuracy of waste parts and effective way to enhance the working performance of a workpiece. Haidou Wang et al. summarize the preparation methods and engineering application of a series of remanufacturing coatings. The operation mechanism of micro/nano multilayer composite coatings with long-term efficacy life was revealed clearly. A series of wear-resistance & anti-fatigue coatings were prepared successfully. A failure-warning intelligent coating based on piezo-effect was designed and sprayed on friction pair surface, which can monitor the state and damage of moving parts real-timely. This paper has an important referential significance for the surface modification of frication pairs and remanufacturing of worn parts.