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EDITORIAL

Micro-tribology

Technological developments over last few decades introduced new and powerful techniques into the field of tribology enabling the scale of experiments to be drastically decreased and micro-tribology fills efficiently a measurement gap between classical tribological experiments and Atomic Force Microscopy (AFM) based nano-tribological techniques. Micro-tribological studies provide an important link between science and engineering enabling development of micro- and nano-scale structures in magnetic storage systems, micro- and nano-electromechanical systems (MEMS/NEMS) and other emerging applications involving tribological contact at sub-millimeter scale. Moreover, macroscopic behaviour of tribological systems is determined by interaction between contacting surfaces at micro- and nano-scales, hence micro-tribology experiments allow tribologists to build fundamental understanding of frictional and lubrication processes.

The seven selected papers published here were presented orally during the 6th International Colloquium on Micro-Tribology held in Osieck (nearby Warsaw), Poland on 9–13 September 2012. They were submitted by the authors after the meeting to this special issue of Tribology – Materials, Surfaces & Interfaces.

The introductory paper by **Kim et al.** focuses on special lubrication effects in the presence of the condensed water vapour. The surface chemistry in such environment influences dramatically on the wear of copper and glass surfaces. The friction and wear behaviours of glass and silica might be expected to be similar since both are based on amorphous Si-O networks and their moduli are similar. In many studies the silica surfaces are used as a model for more complicated glasses. However, their wear behaviours in humid environments are drastically different. Similarly, one expect that when a copper surface is rubbed with a cutter-grade (much harder) stainless steel ball, the copper surface would wear always. But in high humidity conditions, the harder steel ball wears instead of the copper. These observations can be explained only when we fully understand the mechano-chemical interplay at nanoscales between the solid surfaces and molecules adsorbed from the environment.

The next paper by **Gebeshuber and Macqueen** presents the new Asian case method and its introduction to micro/nano-tribology. This case method (inspired by the trademark of professional education of the Harvard Business School) can lead to increase the potential in micro- and nano-tribology research and development, by structuring the ways of thinking and approaching problems in the contributing students/researchers/engineers/business people and by establishing the case method in tribology for more efficient transfer to other fields of science and engineering.

The third paper by **Vite-Torres et al.** reports the micro-abrasion dental wear of restorative porcelains and amalgam. It is a very complex phenomenon in the situation called in tribology as “three body abrasion” since the environment of the tooth-to-tooth contact is complex: the presence of food abrasive particles, tooth abrasive debris, restorative dental material debris or abrasive toothpaste particles. The results of the wear tests of the dental porcelains and

amalgam in the presence of deionized water and artificial saliva with SiC abrasive particles are presented and discussed in this interesting paper.
The next paper by **Abetkovskaia et al.** reviews the application of AFM to study mechanical and tribological properties of materials for the application in MEMS devices. In the presented study the approach is presented which enables to establish the influence of nanoscale polymeric layer thickness on its elastic, adhesive and frictional properties. Thermo-heating stage was applied to perform AFM measurements vs. temperature in the range of 20 to 120^{o}C.
The fifth paper by **Beake et al.** presents the recent progress in nano-scratch testing methodology. The importance of the probe choice, scan parameters and high lateral stiffness of the test instrument in obtaining reliable nano-scratch data is discussed. The film thickness and scratch orientation relative to grinding marks were shown to have a large influence on the critical loads obtained in the progressive load nano-scratch test. The experiments have led to significant progress in determining and clarifying the key test parameters and expected data for input into a best practice guide for nano-scratch testing and subsequent standardisation activity.
The next paper by **Nolbert and Rymuza** presents the model and the results of computer simulations enabling the minimization of friction and adhesion during sliding contacts. It is crucial for the designing and industrial fabrication of many MEMS/NEMS devices as well as in nanotechnological processes e.g. in nano-imprint lithography (NIL) where a silicon mold is used to fabricate polymeric nanostructures by imprinting. The intensive studies of the contact between the mold and PMMA polymeric resist film via advanced modeling and computer simulations have been carried out . The properties of the contacting surfaces have been identified with the Atomic Force Microscope and nanoindentation as well as wettability tester applied for the identification of the surface free energy. A model of contact has been elaborated and adequate original software was used to calculate the frictional and adhesive forces in particular at the silicon mold-polymeric resist interface.
The sliding and rolling of individual micro-sized glass particles on rough silicon surfaces is discussed in the last paper by **Staedler**. The process dynamics of many granular media is dominated by the interaction between individual particles and particles and walls. Up to now this behaviour is only partially understood. A focused ion beam (FIB) system was used to create appropriate holders for various small spherical silica particles with diameter of several to 100 micrometers. Experimental nanoindentation results correlating particle radius , surface roughness, adhesion, and normal load with contact deformation as well as sliding and rolling friction are presented and discussed.

The meeting in Osieck provided a fruitful forum for a group of experts in this unique area of tribology and allowed the exchange of information and ideas in the pleasant environment of a small village in a beautiful Mazowiecki Landscape Park on the Eastern side of the Vistula river nearby Warsaw. We are very grateful to the participants of the conference and the authors for their work and contribution to this Special Issue. The readers are strongly encouraged to read the full text of these stimulating articles.

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