Guest editorial

Resource-efficient machine components

In today's scenario, mankind has to deal with significant problems and issues in the next couple of decades. Living in a world with a continuously increasing population and thus energy demand as well as dramatic changes in the global environment with increasing temperatures (global warming) asks for reasonable and sustainable solution strategies to tackle these global and impactful topics. Potential ways to improve these problems may make use of multi-disciplinary approaches unifying different engineering disciplines, physics, chemistry, biology, social sciences among others. Regarding the continuously increasing energy demand, a key aspect in the near future will be to improve the energy efficiency of processes, systems and/or individual components. In this context, tribological problems and issues have to be considered, as they greatly downgrade the overall efficiency by wasting a significant amount of energy to overcome friction and wear. The importance and significance of tribological problems becomes evident when considering the fact that every system or component contains moving parts (certain velocity and normal load/pressure) in which frictional processes occur. Owing to the number of individual components suffering from frictional losses, this gives a tremendous potential for further improvement.

To improve the performance of individual components with the ultimate goal to increase the overall system's energy efficiency, several aspects have to be taken into consideration. In first instance, manufacturing processes starting from the raw material production and ending up in surface finishing methods can be potentially optimized in a tribological context. These processes may be directly used to create wear-resistant sub-surface microstructures, which would notably contribute to lower run-in periods and significantly reduced wear over time. As tribological systems always consist of two rubbing surfaces in contact, the surface topography plays a major role to manipulate the resulting tribological performance. In this regard, specific surface textures/patterns can be produced on one or both contacting surfaces, which fulfill certain tasks, such as increasing the hydrodynamic pressure to ensure full-film lubrication, to store lubricant and wear debris to improve the frictional performance under mixed and boundary lubrication and to reduce the real area of contact to directly reduce the resulting coefficient of friction (COF). In this context, innovative fabrication methods or the use of biologically inspired hierarchical, multi-scale features may be further considered.

Tribological issues occur when two surfaces are in contact under a certain load and speed, which implies that frictional can never be completely prevented. Therefore, it is of utmost importance to characterize both tribological counter-bodies regarding their tribologically induced changes in surface topography, surface chemistry and microstructure. The detailed knowledge about these aspects and, thus, the underlying friction/wear mechanisms gained by advanced materials characterization can pave the way for optimized tribological systems. This underlines the enormous potential that materials characterization can have to contribute to systems with an improved energy efficiency.

Consequently, this special issue has been initiated to emphasize these aspects and to present summarized latest findings in this interdisciplinary research topic. Therefore, it is hoped that the contributions in this special issue provide the reader a good overview how to efficiently improve the efficiency of machine components. It would be excellent to motivate more researchers to work in this multi-disciplinary, highly challenging research area.

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