

Multi-scale surface patterning to tune friction under mixed lubricated conditions

Rosenkranz, Andreas

Grützmacher, Philipp G.

Murzyn, Kevin

Mathieu, Cedric

Mücklich, Frank

It is well accepted that the tribological performance of surfaces can be directly correlated with their energy efficiency and lifetime. Consequently, surface patterning has gained great attention to manipulate friction and wear under dry and lubricated conditions in the last 2 decades. Inspired by multi-scale surfaces found in nature, direct laser interference patterning (finer cross-pattern) and hot micro-coining (coarser hemispherical patterns) were used to create multi-scale patterns on stainless steel substrates. Using a ball-on-disk set-up, the running-in behavior and the maximum oil film lifetime were characterized for all single- and multi-scale patterns under mixed lubrication.

Compared to the polished reference, all patterned surfaces helped to prolong the oil film lifetime. Synergetic effects induced by multi-scale patterns were observed leading to the best performance of the sample combining deep micro-coined patterns (intermediate area density) with the additional laser pattern. As a result of the additional hydrodynamic pressure generated by the finer laser pattern and the oil reservoir effect as well as the entrapment of wear particles induced by the coarser micro-coined pattern, the oil film lifetime was extended by a factor of 200 (200 times).