PATTERNED SURFACE CONTACT FOR MACRO SCALE ENGINEERING SUPERLUBRICITY

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KEYWORDS

Superlubricity; Surface Topography; Solid Lubrication; Patterned Surfaces

ABSTRACT

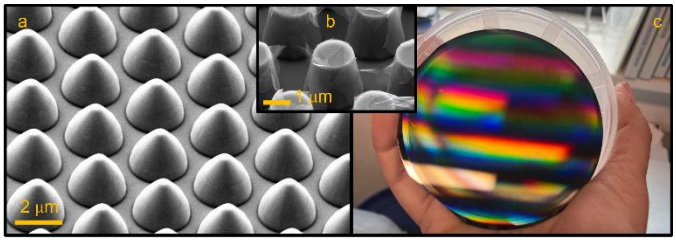

Fig.1 (a) Patterned Si wafer with rounded surface features for incommensurate tribological contact. Surface features are functionalised with a variety of coatings, such as MoS_2 nanosheets as in (b), and surface patterning is evident in the distinct refraction pattern on the Si wafer as shown in (c)

Engineering superlubricity, defined as having a coefficient of friction below 0.01, can be achieved under specific circumstances such as mismatched atomic lattices in two dimensional materials[1] and incommensurate contact in patterned surfaces[2]. The EIC project SSLiP aims to bring this concept to the macro scale, enabling real world applications.

Scale-up is being realized by a combination of concepts including the use of tribocolloids (micron scale colloidal particles with tribological coatings), micropatterned surfaces to reduce contact area, and surface coatings of 2D materials and carrier fluid. These are predicated on ideas around creating a dynamic network of superlubricious contacts that manages total friction through understanding of dissipation in granular systems. Longevity is achieved through the use of regenerative tribochemical and structural patterning solutions, allowing for the low friction domain to be maintained over long cycling periods.

We present a variety of fabrication methodologies including colloidal directed assembly and photolithography to create patterned countersurfaces. Testing is performed with macroscale contact geometries, as well as microscale tribometer contacts to understand underlying mechanisms, and is supported by numerical simulation. Baseline ball and flat on flat friction coefficients below 0.01 have been maintained over thousands of cycles for sub-millimeter contact geometries. We discuss the effect of patterning on our ability to extend these results to larger scales.

ACKNOWLEDGMENTS

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REFERENCES

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