How third body thickness influences sub-surface damage

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Abstract

Experimental evidence shows that dry sliding contacts are characterized by the presence of a third body, i.e. by a layer of solid matter trapped in the interface. This matter originates from the degradation and wear of surfaces during past sliding, and exert an important control on the interface rheology, on its friction coefficient, and on its wear mechanisms. In most cases, however, the precise functional relation between the third body properties and the contact behaviour is unpredictable, and can only be tested experimentally.

In the past decades, progress has been made in the understanding of third body layers through advances in experimental testing and characterization, and numerical modelling. The latter is often based on discrete (e.g. granular) approaches, which allow to represent the possibly discontinuous nature of the third body and the complexity of its kinematics in the sheared interface. Most promising approaches also include the deformability of each third-body particle in order to widen its applicability to pasty or ductile rheologies. In a recent work, such a synthetic collection of third body particles was sheared between two planar bodies, one of which being a linear elastic half space simulated with a meshfree technique close to the finite-element method. This allowed to observe and characterize the tribological loading applied by the third body flow to the subsurface, under the form of stress concentrations and fluctuations in space and time. These simulations showed that the damaging effect of the third body is strongly related to its flow regime, which is in turn controlled by its grain-scale properties.

In this communication, we present new results obtained with the same class of models, by systematically varying the thickness of the third body layer in the simulations. We show that a smaller third body thickness is prone to increase the magnitude of the stress concentrations and fluctuations, and therefore to increase the wear rate. This trend, however, varies from one accommodation regime to the next, and is more pronounced when the third body tends to form large agglomerates. We provide quantitative rules regarding the expected surface damage as a function of third body thickness, and discuss the implications of this result on contact life.

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