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PROCEEDINGS

Rate Effect of Adhesive Wear due to Asperity Plowing

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ABSTRACT

Material wear between contact surfaces with relatively sliding can be related to the failure of elevated asperities at small scales. The asperity wear depends on various factors, including material properties, interfacial adhesion, and friction velocity. In this study, using a series of materials characterized by the modified coarse-grained potentials, we studied the rate effect of adhesive wear at the asperity level over a wide range of plowing conditions. The results showed that increasing plowing velocity leads to the transition of the wear mechanism from plasticity-induced asperity smoothing to the formation of fractured debris and thus breaks down the Archard wear law. For asperity wear dominated by plasticity, the wear rate decreases as the velocity increases; this is because the contact force during asperity collisions strongly depends on the plowing velocity, whereas the wear volume exhibits weak velocity dependence. As the plowing velocity increases, the fractured wear debris forms and dramatically increases wear volume and thus a larger wear rate. Furthermore, it was found that decreasing interfacial adhesion leads to a smaller wear volume and yet a higher contact force. Our findings provide insight into the velocity dependence of wear rate in the tribological test.

KEYWORDS

Adhesive wear; rate effect; asperity plowing; molecular dynamics; wear debris

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