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Experimental and Numerical Study of the Effect of Surface Patterning on the Frictional Properties of Polymer Surfaces

We describe benchmark experiments to evaluate the frictional properties of laser patterned low-density polyethylene as a function of sliding velocity, normal force, and humidity. The pattern is a square lattice of square cavities with sub-mm spacing. We find that dynamic friction decreases compared to nonpatterned surfaces, since stress concentrations lead to early detachment, and that stick-slip behavior is also affected. Friction increases with humidity, and the onset of stick-slip events occurs in the high humidity regime. Experimental results are compared with numerical simulations of a simplified 2D spring-block model. A good qualitative agreement can be obtained by introducing a deviation from the linear behavior of the Amontons-Coulomb law with the load due to a saturation in the effective contact area with pressure. This also leads to the improvement of the quantitative results of the spring-block model by reducing the discrepancy with the experimental results, indicating the robustness of the adopted simplified approach, which could be adopted to design patterned surfaces with controlled friction properties. [DOI: 10.1115/1.4052777]

Keywords: contact mechanics, friction, interface, micro-tribology, stick-slip, surface roughness and asperities, surface treatments, surfaces, tribological systems

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