Tribological behavior of a contact between a glass plane and a PDMS ellipsoidal asperity

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Abstract

In order to control the friction behavior of dry soft contact interfaces, a method for designing and creating elastomeric interfaces with quantitatively controlled friction laws has recently been developed (1). To achieve this, the method considered a simplified topography containing many different spherical microasperities. The developed strategy requires robust characterization of an individual asperity contact in order to feed the upscaling model that relates the macroscopic friction behavior to that at asperity scale. To access richer tribological macroscopic responses, we propose to use asperities with more degrees of freedom than the sphere, namely ellipsoidal asperities.
In this context, we have calibrated the contact between a glass plane and an ellipsoidal asperity in polydimethylsiloxane (PDMS). This calibration was conducted in three phases. Firstly, we performed a characterization of the compression response of the contact, which allowed us to describe the relationship between the real contact area and the normal indentation (δ). Secondly, the shear responses of the contact in two directions (along the two principal axes of the elliptical contact) were characterized, enabling the description of the changes of as the tangential force F is increased at fixed normal force (P). Third, we measured the friction stress of the interface.

These elements constitute necessary inputs for the construction of a multi-contact model which allows to predict the macroscopic tribological behavior of an assembly of many such elliptical microcontacts. Such model will be instrumental to design multicontact interfaces with specified anisotropic friction properties, e.g., the friction coefficient may depend on the direction of shear.
(1) A. Aymard, E. Delplanque, D. Dalmas, and J. Scheibert, Designing metainterfaces with specified friction laws, *Science* **383**, 200 (2024).

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