Study of the true contact area of sheared elastomer/glass contacts using an optical method.

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Résumé :

Nous utilisons une méthode optique récemment développé pour mesurer l'aire de contact réelle à l'interface entre une surface élastomère et une plaque de verre. Nous montrons d'abord que l'aire de contact réelle diminue significativement sous cisaillement. Ensuite, nous comparons nos mesures avec deux modèles de la littérature. Nous utilisons ces résultats pour mieux comprendre le comportement des interfaces multicontacts cisaillées.

Abstract :

We use a recently developed optical method to measure the real contact area at the interface between an elastomeric surface and a glass plate. We first show that the true contact area decreases significantly under shear. We then compare our measurements with two models from the literature. We use these results to better understand the behavior of sheared multicontact interfaces.

Keywords : tribology, true contact area, contact imaging, optimization, mono contact, shear rupture

1 Introduction

The study of the shear rupture mechanisms of contact interfaces is difficult because these confined interfaces are usually not directly accessible to measurement. To overcome this difficulty, we developed a non-invasive optical method to observe the transparent contact interface between an elastomeric slider and a glass surface [1]. We performed a study of the optimization of the image acquisition procedure to allow for an efficient separation of the regions in and out of contact. Here, we apply our insights to a system of interest in tribology: the sliding of the interface between a polydimethilsiloxane (PDMS) sphere and a smooth glass plane.

2 Results

We first show how the area of a single sphere-on-plane contact decreases, by up to 20%, as the tangential force is increased. The initial circular shape of the contact is also modified to a pseudo-elliptical shape as the area decreases (fig.1). We compared our area measurements with two existing models from the literature [2, 3] and found that they do not model satisfactorily all of the observed phenomena.

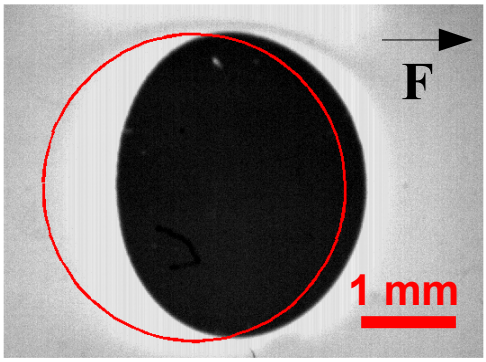

Figure 1: Image of a smooth PDMS sphere and a smooth glass plate interface under shear force F. The red circle is the initial shape of the contact.

We then show that the true area also decreases in the case of a multi-contact between a rough rubber slab and the same smooth glass plate.

3 Conclusion

Our results should be useful to relate the true contact area under purely normal load, which is the object of many contact mechanics models, to the area which is actually relevant at the onset of sliding of a multi-contact interface.

Références

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