NANOSCALE STUDIES OF FRICTION AND WEAR

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ABSTRACT

I will discuss recent experimental studies of nanoscale single asperity contacts that reveal surprising new behavior and insights. First, the behavior of nanoscale contacts with truly 2-dimensional materials including graphene will be discussed. We find that the friction force exhibits a significant dependence on the number of 2-D layers[1]. Surprisingly, adhesion (the pull-off force) does not. However, studies as a function of scanning history reveal further complexities that arise from the combined effects of high flexibility and variable substrate interactions that occur at the limit of atomically-thin sheets. I will then discuss new insights into nanoscale wear. A better understanding of the physics of wear would allow the development of rational strategies for controlling it at all length scales. As well, wear is a primary limitation of devices such as micro-/nano-electromechanical systems (MEMS/NEMS). We show that ultrastrong materials can be used to be greatly reduce nanoscale wear[2-5]. We have also demonstrated the ability to characterize single-asperity wear with a high degree of precision by performing *in-situ* wear tests inside of a transmission electron microscope. Silicon probes of different initial radii and shape were slid against a flat diamond substrate. The shape evolution and volume loss due to wear are well described by kinetic model based on stress-assisted bond breaking mechanisms[6], allowing new insights to be gained about the kinetics of atomic-scale wear[7].

Références

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