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Measurement on critical shear stress of circular point contact utilizing Atomic Force Microscope

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Abstract

We propose Bowden-Johnson-Kendall-Roberts model to measure the critical shear stress of circular point contact, and the critical shear stress map is constructed through the lateral force mode and force map mode of Atomic Force Microscope to research the interface property of nanomaterials. The mean critical shear stresses are measured as 0.24 MPa for monolayer MoS₂ and 0.69 MPa for graphene. MoS₂ nanosheet and graphene are of the lower critical shear stress and friction coefficient than those of the bulk materials, which are good agreement with the regularities in nanotribology. The critical shear stress can be used to not only quantitatively characterize the frictional properties, but also analyze the friction at different loading stages. The critical shear stress map would play an important role in sliding contact of nanomaterials for the drive part design and nanotribological reliability of nanoelectronic mechanical system.

Keywords: Atomic Force Microscope, Wear and tribology, Interfaces.

1. Introduction

Due to the large surface-to-volume ratio and strong surface effect, there are distinguishing friction behaviors between nanomaterials and bulk materials, therefore the traditional tribological theory and experimental method are no longer suitable for nanotribology [1]. The friction coefficient can be obtained by using linear fitting to describe frictional property of nanomaterials, but the evaluated results are

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