Influence of abrasive shape on the abrasion and phase transformation of monocrystalline silicon

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1. Movement pattern of abrasive particle

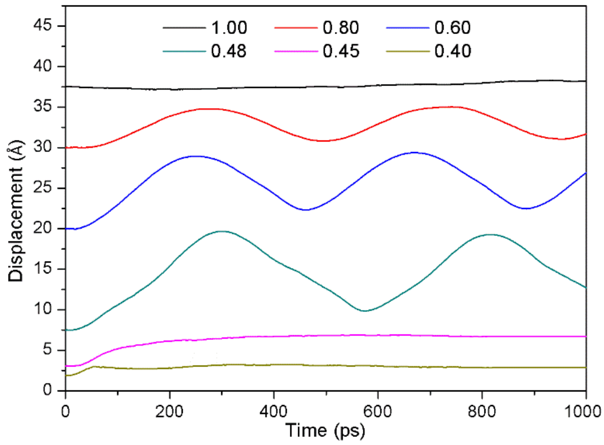


Figure S1. Displacement of the upper specimen along y-[010] direction vs. time and axial ratio. The ordinate value was just used to examine the amplitude of curves.

2. Prediction of the movement pattern

The prediction of the movement pattern of particle is very important to determine the morphology of worn surface and thereby predict the change of wear mechanism. The criterion for movement pattern of particle has been established to quantitatively characterize the correlation between theoretical and experimental or simulated studies [1-6]. Fig. S2 depicts the forces between the moving ellipsoidal particle and the bottom silicon specimen. Here, the interaction between particle and the upper specimen is omitted due to the system symmetry. Point *S* is assumed as a central contact point of distributed forces on the particle surface, and point *O*, the geometric center of the ellipsoidal particle. This simplified model has been reported by the present authors [1, 2]. N and F are normal load and friction force acting on the particle by the surface of specimen, and v represents the movement direction of upper specimen. Thus, based on the force equilibrium correlation, the aforementioned criterion can be described by the following formulas [1-6]:

$$e/h \geq \mu \qquad \text{(for sliding particle)} \tag{1}$$

$$e/h < \mu \qquad \text{(for rolling particle)} \tag{2}$$

where $\mu = F/N$ is the friction coefficient of particle, e and h represent the distance between point S and the geometric center of ellipsoidal particle (point O) along x and y direction, respectively.

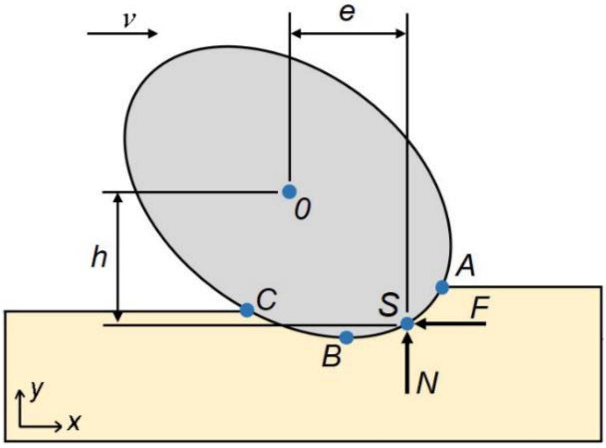
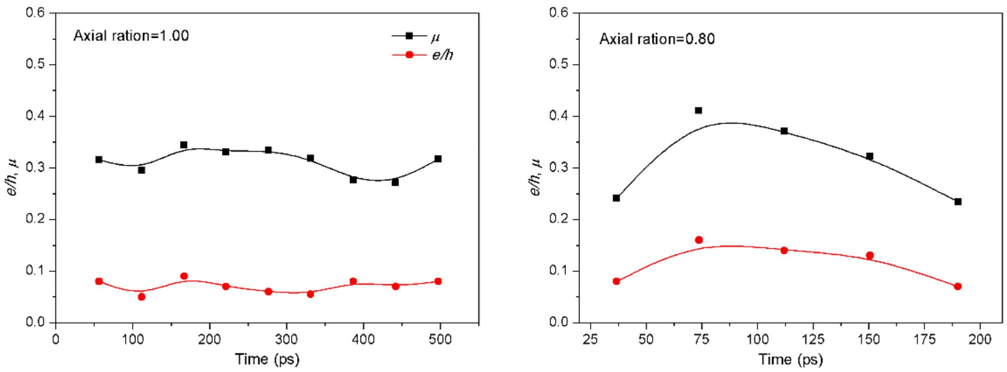


Figure S2. Schematic of forces on an ellipsoidal abrasive particle in three-body abrasion. A, B and C are the contact points between the particle and substrate surface.



(a) **(b)**

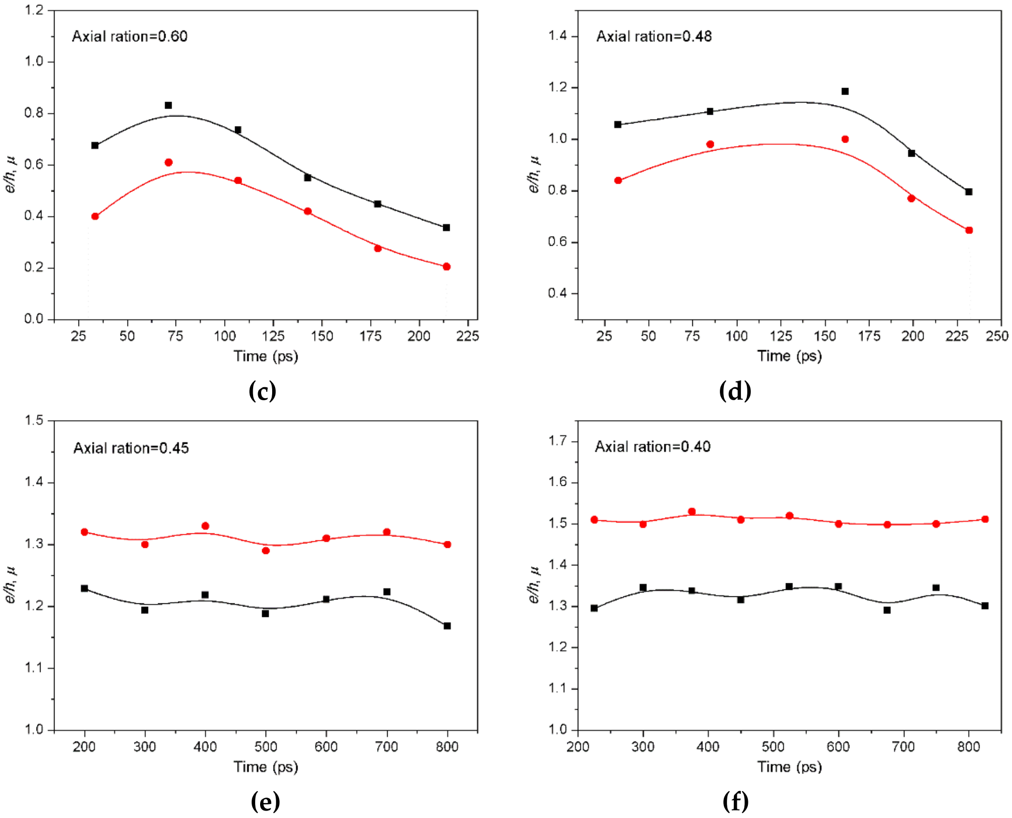


Figure S3. Friction coefficient (μ) and e/h value vs. simulated time at different axial ratio.

References

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