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Frictional Behaviour of Various Kinds of Molybdenum Disulfide

各種二硫化モリブデンの摩擦特性

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1. Introduction

Two of the authors (M. M. and T. N.)[1] investigated the effect of various vapours on the coefficient of friction of clean molybdenum disulfide (MoS_2), and found two minimum points appeared on figures, which represented the relationship between the coefficient of friction and vapour pressure. A school of thought in Japan including the authors hypothesized that two minima were originated from different adsorption sites, that is, cleavage plane and polar area. Frictional behaviour and effect of various vapours on various kinds of MoS_2 powders which had different surface properties, including single crystal, were investigated according to the same method previously reported.[3]

2. Used MoS_2 specimens

MoS_2 specimens used in the experiment were cleavage surface of a single crystal, oleophilic MoS_2 and air ground MoS_2. The latter two specimens were prepared by Groszek[2], and these had different proportion of basal plane and edge as shown in Table 1. An electronmicrograph of the air ground MoS_2 is shown in Fig. 1. The powders were deposited on a copper substrate by electrophoretic coating from acetone suspension, as previously reported.[1]

Table 1. Surface properties of MoS_2 powders (from Groszek[2])

Type of Powder	Surface Area m²/g	
	Basal Plane Area	Polar Area
Oleophilic MoS_2	28.9	11
Air ground MoS_2	7.9	150

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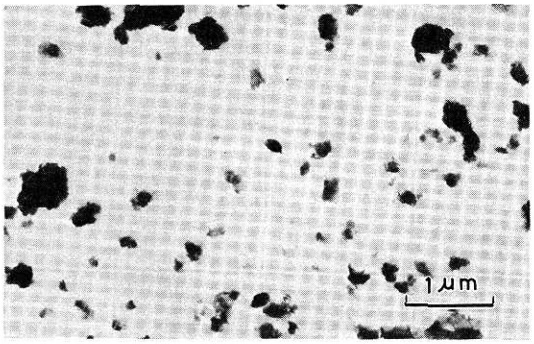

Fig. 1. Electronmicrograph of air ground MoS_2

3. Friction tests

Friction tests were performed by the same method as the previous report. Effect of dry air on the coefficient of friction of oleophilic MoS_2 is indicated in Fig.2. The results shows similar effect

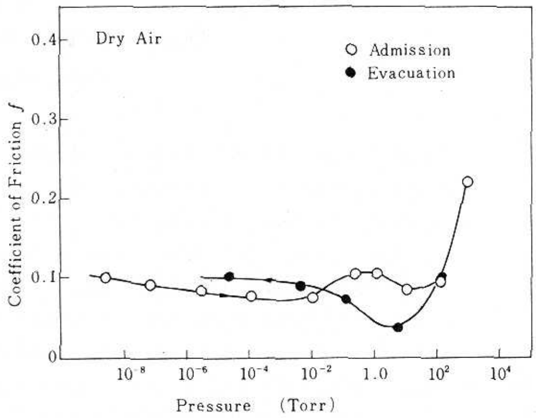

Fig. 2. Variation of coefficient of friction with dry air pressure for oleophilic MoS_2

as the ordinary powders, and disimilar to that of cleavage plane of the single crystal. The oleophilic MoS_2 had a large proportion of basal plane area, but electrophoretic coating gathered MoS_2 powder which had large proportion of polar area. Scanning electron micrographs on deposited surfaces showed similar appearance independent of the kinds of MoS_2.

Effects of water vapour and dry air on air ground MoS_2 are indicated in Fig. 3 and 4. These

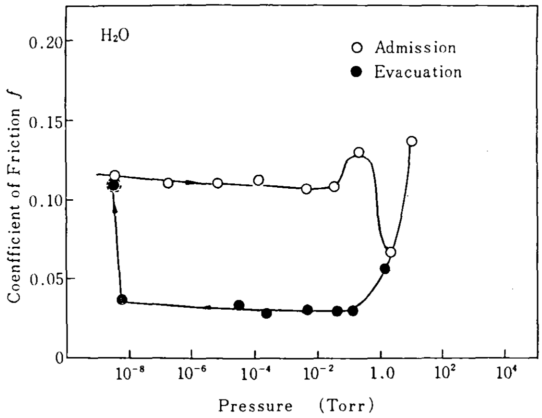

Fig.3. Variation of coefficient of friction with water vapour for air ground MoS_2.

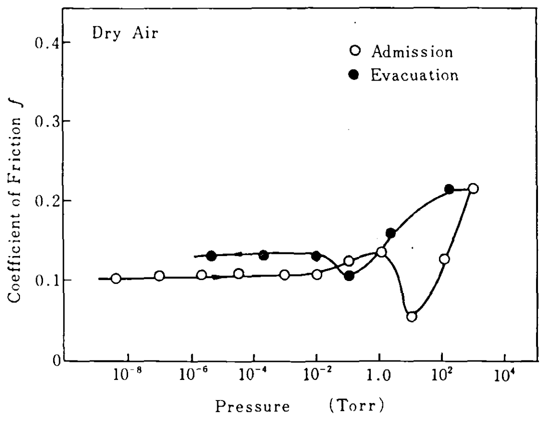

Fig.4. Variation of coefficient of friction with dry air for air ground MoS_2.

results are also similar to these of ordinary MoS_2 powders, except ehat the water vapour was more difficult to evaporate with air ground specimen as shown in Fig.3. This indicated that more polar area which is a high energy surface could adhere the water vapour more tightly. Effects of dry air, water vapour and propane on the coefficient of friction of the basal plane of MoS_2 single crystal are shown in Fig. 5, 6 and 7, respectively. It can be

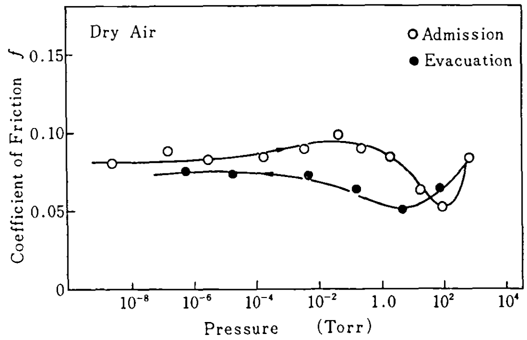

Fig.5. Variation of coefficient of friction with dry air for cleavage plane of MoS_2 single crystal.

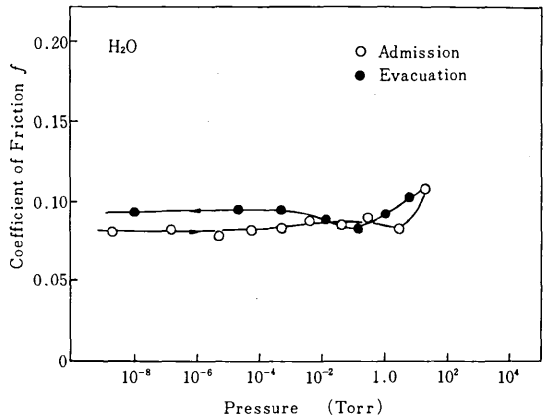

Fig. 6. Variation of coefficient of friction with water vapour for cleavage plane of MoS_2 single crystal.

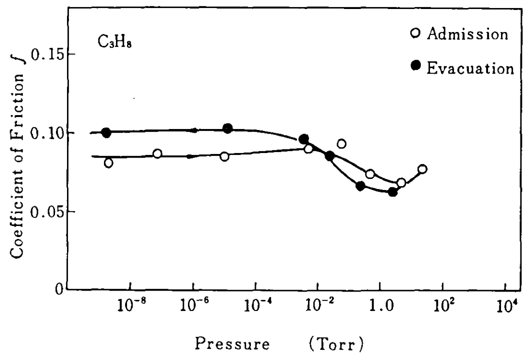

Fig. 7. Variation of coefficient of friction with propane for cleavage plane of MoS_2 single crystal.

seen that the curves are nearly flat, in comparing with these of the other MoS_2 specimens, although slight maximum and minimum points appeared. It is hypothesized by the present authors that these vapours have no effect on the friction of the MoS_2 basal plane. The slight variations in the curves are originated from the polar area, because contact of polar area and slider surface was inevitable on account of wear of MoS_2 during sliding.

4. Conclusion

It was concluded that the frictional behaviours influenced by the vapour adsorption were originated from polar area of MoS_2 and the coefficient of friction of basal planes was not affected by the vapour adsorption.

Acknowledgement

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