FRICTION BEHAVIORS OF TANGSTEN DIESULFIDE AT ELEVATED TEMPERSATURES

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ABSTRACT

Solid lubricants are one of the most important materials in space-crafts, which are always exposed to extreme environments like high vacuum, high and low temperature cycle and atomic oxygen. Tungsten disulfide (WS_2), which due to its peculiar characteristics is expected to be applied at higher temperatures than conventionally used molybdenum disulfide (MoS_2), both sulfides have a unique hexagonal layered structure and a very low friction coefficient by sliding between sulfur layers. Our previous studies[1,2] have suggested that lattice defects such as stacking faults are a key role in the low-friction mechanism. The objective of this research is to clarify the temperature dependence on friction coefficients of WS_2 and to analyze the obtained images of lattice defects to demonstrate their relationship with the low–friction mechanism of WS_2. In this study, WS_2 coated SUS316 stainless steel disc were fabricated by the supattering technique. A rotational friction tests whose load was 9.8N were carried out to measure the friction coefficient at 25,100, 200, 300 and 400℃, up to $9.0X10^3$ m distance. During rotational friction tests, WS_2 flakes have been created on the wear track. These WS_2 flakes were observed by using a Transmission Electron Microscope (TEM) model JEM2000FX operated at 200keV. Figure 1 demonstrate the temperature dependence of the frioction cefficient of WS_2 suppttered films. Friction coefficient shows minimum values at 200℃ and increases with test temeratures. This behaviors have been also observed in WS_2 shot peening of films. In Fig.2, bright field image shows typical moiré pattern which spacing is 6.0 nm. When two of WS_2 thin plates overlapped together, rotational moiré pattern will be appeared. Calculated rotational angle is 2.4 degrees which is quite small. The observation of this moiré pattern and very small rotational angle would strongly suggest the existence of lattice defects such as a partial dislocation on WS_2 (0002) plane. Sliding mechanism of WS_2 will be dicussed in conjuction with the compelex stcking fault in WS_2 2H layered structure.

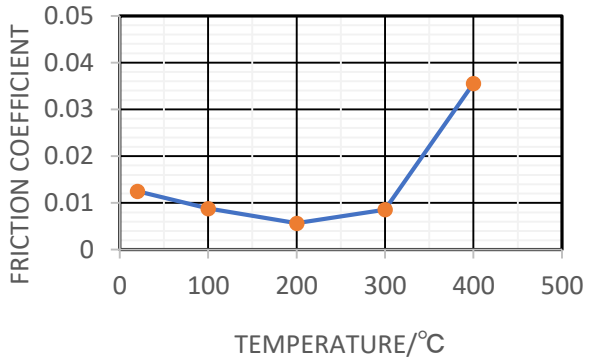

Fig.1 Temperature dependence of friction coefficient of WS_2 spatter film

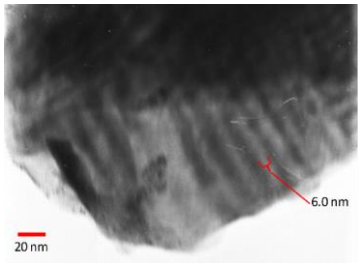

Fig.2 Observation of moare pattern (partial dislocation) in WS_2 wear powder

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