Effect of Copper-Molybdenum Oxide on the Tribological Properties of Aluminum Bronze Alloy at High Temperature

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1. Introduction

Aluminum bronze is one of the conventional bearing materials which can be applied at high temperature up to around 300 °C. However, at the temperature of over 400 °C, it shows high friction coefficient and poor wear resistance. The improvement of wear resistance of aluminum bronze at high temperature by the addition of silicon-manganese particles to the aluminum bronze has been reported [1)]. On the other hand, the lubricity of many kinds of metal oxide at high temperature has been studied. It was reported that molybdenum trioxide showed superior lubricity at high temperature of about 700 °C [2)]. In this experiment, we applied MoO_3 to enhance the wear resistance of aluminum bronze at high temperature and studied the effect of it on the tribological properties of aluminum bronze.

2. Experiment

Aluminum bronze and stainless steel were used as the disk and the ring specimen respectively. The sliding surface of the ring specimens were sandblasted, then MoO_3 fine powder was rubbed and adhered onto the blasted surface. The sliding test was conducted with the ring-on-disk apparatus. The applied pressure was 0.46 MPa and the sliding speed of the ring specimen was 55 m/s. The atmospheric temperature was controlled to be from the room temperature to 700 °C.

3. Results and discussion

The MoO_3 coated specimens showed low friction coefficient in comparison with that of uncoated specimens at the temperature of over 500 °C as shown in Fig.1(a), and the MoO_3 reduced the wear of aluminum bronze and stainless steel at the temperature of over 400 °C as shown in Fig.1(b) and 1(c). The friction test of the uncoated specimen at 700 °C was aborted because of considerably large friction force, thus there is no data for the uncoated specimen at this temperature. A certain quantity of molybdenum was detected from the wear tracks of aluminum bronze tested at the temperature of over 500°C by electron probe microanalysis. As a result of X-ray diffraction analysis of the wear tracks of the specimens, it was considered that a sort of copper-molybdenum oxide was generated on the wear track and it contributed to reduction of wear of aluminum bronze.

4. Summary

The application of MoO_3 fine powder to the sliding interface between aluminum bronze and stainless steel reduced the friction coefficient and the wear of both materials at high temperature. The copper-molybdenum oxide, which supposed to be $Cu_3Mo_2O_9$, generated on the wear track seems to be acted as high temperature solid lubricant.

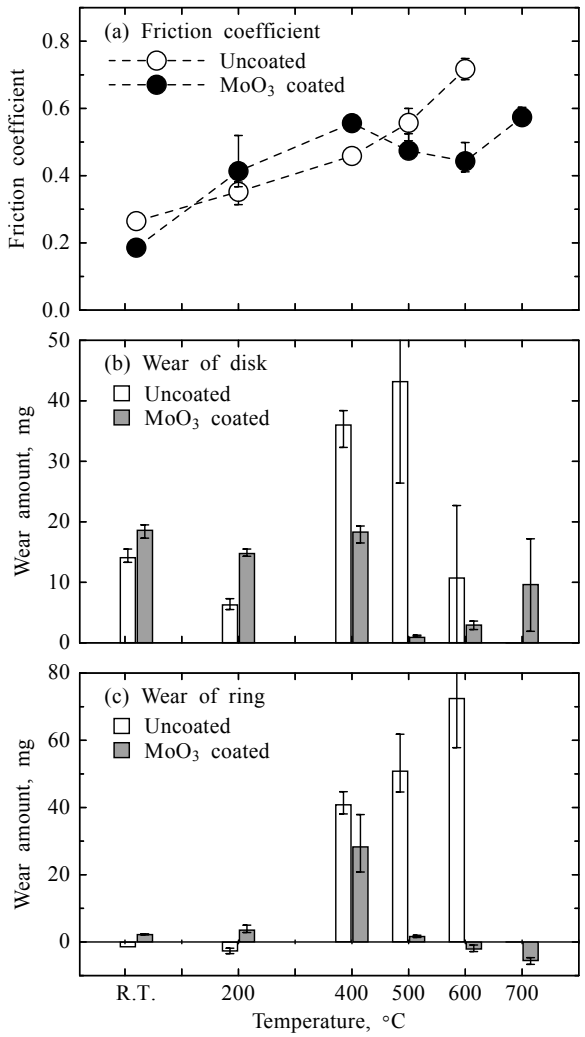

Fig. 1 (a) The friction coefficient, (b) the wear of the disk (aluminum bronze) specimen and (c) the wear of the ring (stainless steel) specimen.

5. References

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