

SURFACE MODIFICATION AND SOLID LUBRICANT COMPOUNDING OF HIGH-STRENGTH BRASS ALLOY BY FRICTION STIR PROCESSING

M. Hirukawa ^{a*}, S. Kawada ^b, K. Sato ^a, M. Miyatake ^a, S. Sasaki ^a, T. Inagaki ^c, H. Tomita ^c

*4523559@ed.tus.ac.jp

^a Tokyo University of Science, 6-3-1, Niijuku, Katsushika-ku, Tokyo, 125-8585, Japan

^b Kansai University, 3-3-35, Yamate-cho, Suita-shi, Osaka, 564-8680, Japan

^c Oiles Corporation, 8, Kiri-hara-cho, Fujisawa-shi, Kanagawa, 252-0811, Japan

KEYWORDS

Friction; Wear; Solid lubrication, Friction Stir Processing (FSP)

ABSTRACT

To improve the wear resistance of high-strength brass alloys, which are widely used in sliding parts such as plain bearings, various methods such as dispersion of intermetallic compounds have been adopted [1]. In recent years, further improvements have been required to extend the life and optimize the performance of machines and devices that use these alloys as sliding materials. This study focuses on Friction Stir Processing (FSP) to enhance the wear resistance of high-strength brass CAC304C (the alloy components are detailed in Table 1) through surface modification using the FSP technique combined with a solid lubricant mixture and subsequently evaluates its wear resistance. As shown in Figure 1, FSP was conducted on the surface of CAC304C specimen sized 37×37×21mm, utilizing a ϕ 4mm tungsten carbide tool. The specimen surface was machined with 1 mm wide and 1 mm deep grooves, which were subsequently filled with hexagonal Boron Nitride (hBN) powder. FSP facilitated surface modification of the specimens and compounding with solid lubricant. Test specimens, 24 mm in diameter and 10 mm thick, were machined from the FSP-applied material. The tribological properties of the test specimens were assessed using a Bowden-Leben-type friction testing machine. The operational parameters for the sliding test were as follows: mating ball material SUJ2 (ϕ =10 mm, 800HV), lubricating oil: 50 μ L of Shell Tonna S3 M 68 oil (ISO VG68), load=20 N (resulting in a Hertz contact pressure of 0.985 GPa), sliding velocity=20 mm/s, sliding amplitude=10 mm, and total sliding duration=60 minutes.

Figure 2 depicts electronic images of the test specimen surfaces observed via SEM-EDS. The dendritic precipitates composed of Fe in the base material dispersed finely after FSP; this indicates that the crystal grains were refined by FSP. In addition, from the elemental map and the mass concentration results, Nitride elements exist after FSP, it is showed that hBN was mixed in the surface of the test specimen by FSP. Figure 3 illustrates the average values of the friction coefficient and wear amount. The results of comparing the two cases indicates that the amount of hBN filled in the grooves set up in this test was not enough to provide its good friction properties. The

amount of wear decreased about 10% in the case of FSP with hBN. This reveals that FSP process with mixing hBN improved the wear resistance of high-strength brass alloy.

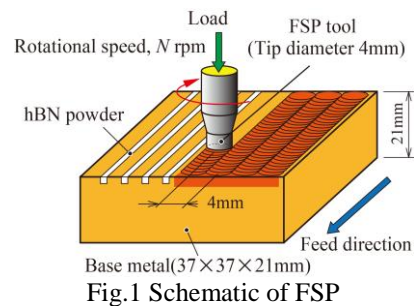


Fig.1 Schematic of FSP

Table 1
Components of CAC304C (%)

Cu	60.0-65.0
Zn	22.0-28.0
Al	5.0-7.5
Mn	2.5-5.0
Fe	2.0-4.0

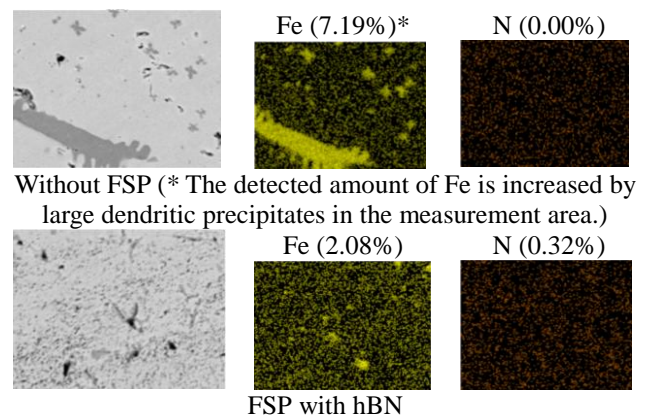


Fig. 2 Surface images of specimens and elemental maps

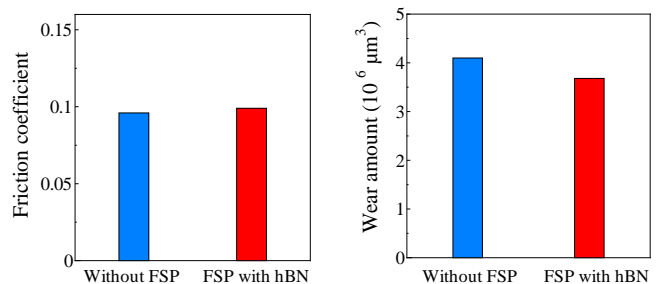


Fig.3 Friction coefficient and wear amount

REFERENCES

- [1] Suwa, M. and Matsumoto, K., "Mn₅Si₃ dispersed anti-wear copper alloy," Hitachihyoron, 55, 6, 1973, 607-611