

Study on Ionic Liquids in the Electric Field

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1. Introduction

Ionic liquid, a substance consisting of cation and anion, is a salt in the liquid state at room temperature. It has various characteristics such as high thermal stability, low vapor pressure and conductive properties. Given these characteristics, it is expected to be used as lubricants especially under high vacuum and high temperature conditions [1]. In order to use as lubricant, it is required that the problem such as corrosion and decomposition are solved. In addition, it is known that the mechanical properties, such as change the film thickness, are affected by electric fields. From this, it is expected that the tribological properties of the ionic liquid are improved in electric field. Currently, many studies regarding to corrosion and decomposition of ionic liquids have been carried out [2]. However, about conductive effects of electric field on tribological properties of the ionic liquids is less.

In this study, we examined the tribological properties of the ionic liquid when the voltage applied.

2. Experimental

Ionic liquid used in the experiments was [EMIM] [DCN]. Experiments were performed by using the ring-on-ring type tribo-meter as shown in Fig. 1. For the specimens, disks made of phosphor bronze were used. Direct current voltage was applied between the specimens which were insulated. The shear was measured by changing the voltage applying. Experimental conditions are listed in Table 1.

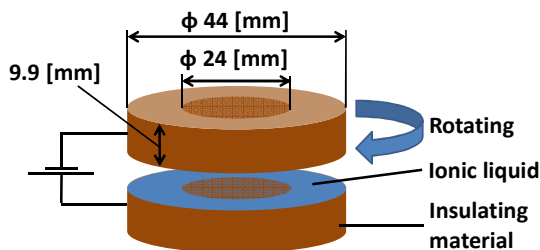


Fig.1 Schematic of sliding tester

Table 1 Sliding test condition

Lubrication condition	Fluid lubrication
Voltage [V]	0, 5, 10, 20
Rotation speed [rpm]	100
Time [s]	30
Lubricant [μ l]	200
Temperature	Room temperature

3. Result and Discussion

Figure 2 shows the shear force in the electric field in case of [EMIM] [DCN]. From the figure, the shear force increased when electric field was applied, compared to that when electric field was absent. Also, the amount of increased shear force was corresponding to the magnitude of voltage. It is considered that the fluctuation of shear force is because of viscosity change of the ionic liquid. In this case, viscosity increased because of the fluid lubrication.

It is expected that the increase of the viscosity of the ionic liquid has improving effects of the tribological properties in the boundary lubrication and mixed lubrication.

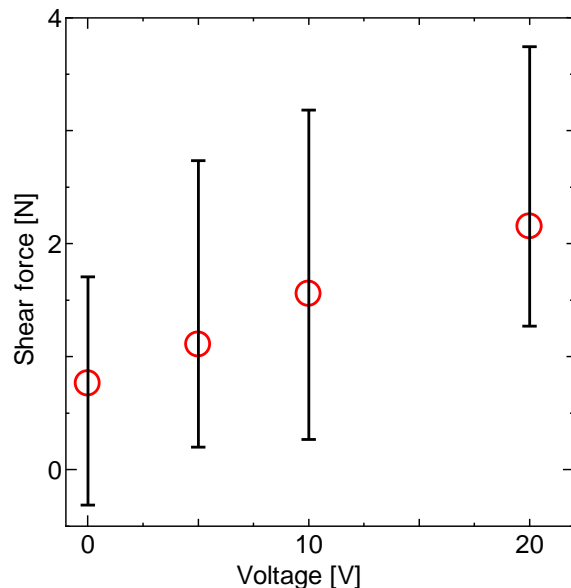


Fig.2 The shear force of each voltage

4. References

- [1] H. Kamimura, et al.: "Effect and mechanism of additives for ionic liquids as new lubricants", *Tribology International*, 40, 4, 2007, 620-625.
- [2] Y. Kondo, et al.: "Lubricity and corrosiveness of ionic liquids for steel-on-steel sliding contacts", *Proc. IMechE Part J: J. Eng. Tribol.*, 226, 11 2012, 991-1006.