# Position-Shift of Triboplasma Generation Observed by Temperature Measurement as the Origin of Tribochemical Reactions

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## 1. Introduction

Previously, it has been reported that triboplasma is generated in the rear gap of sliding contact. However, recently we have observed that the triboplasma is also generated in front of and inside of the sliding contact. Further, we have succeeded to measure the temperature distribution of triboplasma. This paper reports the distribution and flow of triboplasma generated in front of and in the rear gap of the sliding contact with the correlation of tribocharging distribution on the sliding surface.

## 2. Experimental procedure

Temperature distribution at and around the sliding contact was measured using a highly sensitive infrared camera (FLIRATS SC7600-BB) together with friction coefficient at a tribosystem of insulator/insulator, i.e., a diamond pin sliding with a tip radius r = 4mm on a sapphire disk under $F_N$ = 1N and the rotational velocity ω = 10 to 155 rpm (wear track dia. d = 40 mm). Tribocharge-induced surface potential was also measured simultaneously with the negatively and positively charged particles from the triboplasma using a non-contacting type surface potential measurement apparatus[1)] and the specially invented triboemission measuring apparatus[2)].

## 3. Results and discussion

Figure 1(above) shows time dependence nature of the temperature distributions at and around the sliding contact measured by the infrared camera at the second sliding revolution from 7s to 12 s under ω = 10 rps. The plasma temperature was very low and not greater than 0.15℃ at this rotational velocity. This means that the triboplasma is non-equilibrium low temperature plasma. In the second sliding revolution, the triboplasma was generated first in front of the sliding contact (6s) and then shift to the rear gap of the sliding contact (7s). The rear plasma intensity increases (8s) and increases (9s) and then decreases (10s) and becomes very weak (11s). The phenomena occured repeatedly with one revolution time of 6s at ω = 10 rps. This process of the plasma generation is caused by the distribution of the tribocharge-induced surface potential as explained by the electron avalanche process as shown in Fig. 1 (below). It was also observed that distribution of the triboemission intensity of the negatively and positively charged particles from the plasma correlated well with the tribocharge-induced surface potential distribution.

## 4. Summary

Triboplasma is non-equilibrium low temperature plasma. The position and intensity of the plasma change depending on the strength of the tribocharge where sliding contact is located. Namely, triboplasma position and intensity shift from the place “in front gap of”, through that “inside gap of” and to that “in the rear gap of” the sliding contact in one revolution of rotation. This means that triboplasma reactions occur not only in the rear gap but also in front of and inside of the sliding contact.

## 5. Acknowledgement

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## 6. References

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2) Nakayama K., Suzuki N. and Hashimoto, H., “Triboemission of charged particles and photons from solid surfaces during frictional damage, J. Phys. D: Appl. Phys., 25, 1992, 303-308.

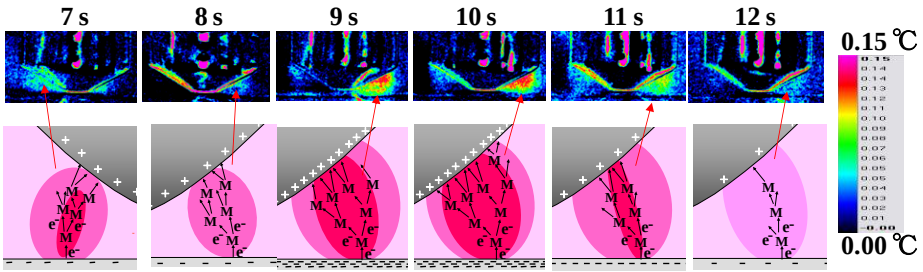


**Fig. 1** Triboplasma temperature distributions (above) and electron avalanche process (below).