

## Microplasma Generation at a Sliding Contact

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It has been proposed that microplasma is generated in the gap of the sliding contact. As the plasma emits electrons, ions, and photons, we can get plasma image by measuring a two-dimensional image of photons emitted from the plasma, i.e. plasma image. The apparatus to measure the two-dimensional photon image was constructed, and using it the plasma image was successfully measured from the backward through a sapphire disk and side ward through the gap. The apparatus consisted of an optical microscope, highly sensitive intensified charge coupled device (ICCD), and computer-processed.

Figure 1 shows the plane image of the plasma generated in the gap of the sliding contact between a hemispherical diamond pin with a tip radius of  $300\ \mu\text{m}$  and a sapphire disk with a thickness of  $1\ \text{mm}$  measured from the backwards through the disk. The plasma spread in the rear of the sliding contact resemble a shape of a comet with the major axis beyond  $100\ \mu\text{m}$  tailing beyond  $100\ \mu\text{m}$  and emitting intensive photons in the region out of the contact. This means that the traditional concept, that frictional heating emits photons from the sliding contact itself is not correct.

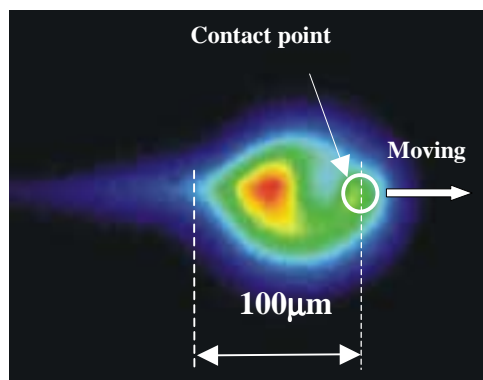


Fig. 1 Plane image of plasma with comet shape

Figure 2 shows the plasma image measured through an optical filter, which passes only ultraviolet (UV) light, i.e. UV plasma image. The UV image had a horseshoe pattern as seen in Fig. 2. By analysis of the spectral of the UV light, the gas discharge plasma model was proved. As the comet-shaped image in Fig. 1 contains infrared photons emitted by frictional heating, the UV-horse shoe pattern is the plasma image.

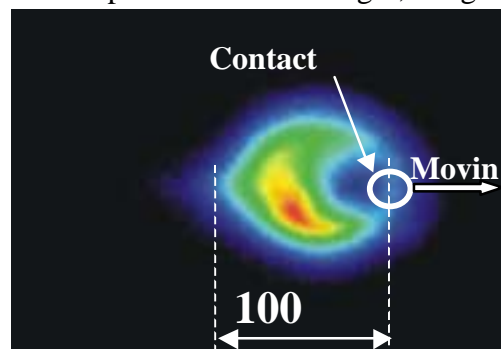


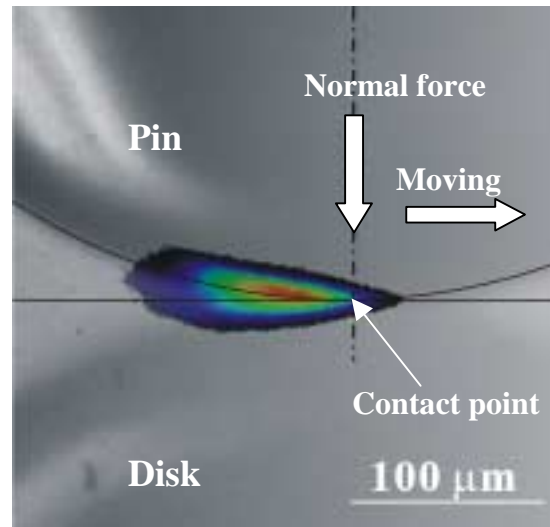
Fig. 2 UV image of

Figure 3 shows the side view of the plasma measured from the sideward of the sliding contact. As the optical axis was inclined a little above the disk surface, the reflected image of the plasma (the image below the horizontal line) was also accompanied. The plasma is definitely generated in the gap of the sliding contact. Further, we have succeeded to measure the movie of the plasma. From the movie, we found that the shape and the distribution of the plasma change with time. The plasma

was observed under as low velocity as 2 cm/s and as low load as 3 g. The plasma was found being generated for almost all materials including insulators, semiconductors and oxide covered metals. From these facts, it can be said, “Wherever solid is rubbed, microplasma is generated”.

#### References

1. Keiji Nakayama and Roman A. Nevshupa, Plasma Generation in a gap of sliding contact, J. Phys. D: Appl. Phys., 35(2002) L53-L56.



**Fig. 2 Side view of plasma**