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DECOMPOSITION OF OILS BY ACTION OF DISCHARGE PLASMA(1)
-ORIGINAL DISCHARGE PLASMA GENERATOR-

One of the main problems in alternators is the extremely short fatigue life of the rolling bearings. As a possible cause of the short life, it has been assumed that hydrogen is produced inside the bearing and then it penetrates into the bearing material to cause hydrogen embrittlement, which results in the short life. However, it is unknown from where the hydrogen comes. On the other hand, it is reported that plasma is generated in oil lubrication. In this study, we invented a new apparatus that generates discharge plasmas in oil. Using it, we have investigated whether hydrogen is produced or not through oil decomposition by discharge plasma action.

Figure 1 (a) and (b) shows the principle of the needle-plate electrodes type plasma generator that we invented and the chromatograph to analyze the gases evolved by decomposition of oils due to discharge plasma action, respectively. Discharge was geneared between the needle and plate electrodes in oil, where a voltage was applied between the electrodes using an external high voltage power supply (HV). Prior to the experiments, the chamber was filled with dry air by passing dry air into the chamber for 30 seconds to eliminate the effect of moisture. The discharging was generated for 10 seconds, during which current and voltage were monitored using an oscilloscope. After discharging, leaving it for 20 seconds, the gases produced in the chamber were sampled using a microsyringe and then they were inserted into the chromatographic column to measure the amount of H_2.

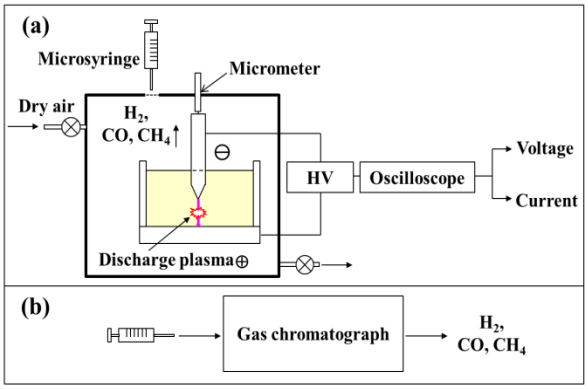

Fig.1 Schematic view of discharge plasma generator.

Figure 2 shows the relation between the amount of hydrogen produced in *n*-hexadecane for 10 seconds discharging and the electrodes distance. It is shown that the amount of hydrogen decreases with increasing electrodes distance, having the smallest data variation at 50μm. Figure 3 shows the amount of hydrogen versus discharge time at the electrodes distance of 50μm in *n*-hexadecane. The amount of hydrogen rapidly increases with increasing discharge time and then saturates at 30 to 40 s. Based on these data, we adopted the electrodes distance of 50μm and the discharge time of 30 s for the experimental condition, in which we could successfully acquire reproducible data.

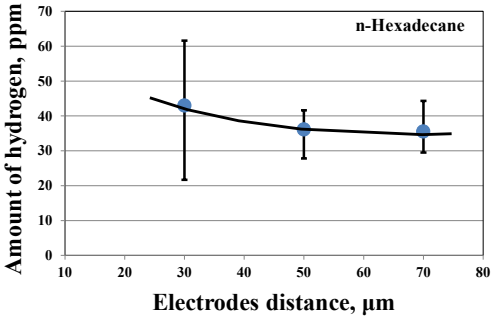

Fig.2 Dependence of hydrogen production on electrodes distance

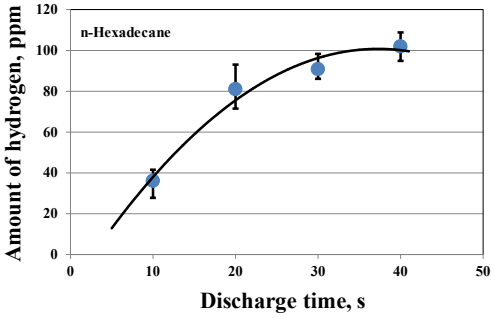

Fig.3 Dependence of hydrogen production on discharge time

The needle-plate electrodes discharge plasma generator invented in this study enabled discharge plasma generation, not only in air but also in oil. Using the plasma generator, we have verified that the straight-chain hydrocarbon oil is decomposed by discharging in oil to produce hydrogen. Reaction mechanisms of oil decomposition due to plasma action will be further examined from various perspectives for both in base oils and additives to develop new applied plasma technologies.

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