

Effect of temperature on chemical activity of nascent steel surface

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1. Introduction

Chemical reactions of lubricant components under boundary lubricating conditions are affected by the chemical activity of material surfaces. Although surface is covered with metal oxides under mild conditions, nascent metal surfaces formed under severe conditions play an important role on tribochemical reactions of lubricant components. We have been studying on chemical activity of nascent surfaces of metals and ceramics[1]. In this study, the effect of temperature on the chemical reactions was investigated using a unique method with a mass spectrometer.

2. Experimentals

Nascent surface of steel was formed by scratching under high vacuum conditions. Sample gas was introduced from a variable leak valve, and evacuate continuously by TMP. Adsorption of sample gas and evolution of reaction products were monitored by a quadrupole mass spectrometer. Temperature of specimen was controlled by a heater and was monitored with a thermocouple.

Mild steel and benzene, benzene-d₆(C₆D₆) and ethyl alcohol were used as a specimen and sample gases, respectively. The temperature of specimen was controlled 30 to 110 °C.

3. Results and Discussion

Benzene chemisorbed on nascent steel surface easily and hydrogen evolution as a decomposition product was observed. Adsorption rate of benzene decreased but hydrogen evolution rate increased at elevated temperature[2]. This suggests that there is a different hydrogen source except for benzene. Decomposition reaction is investigated by a tracer method using C₆D₆. The result is shown in **Figure 1**. It is obvious that adsorption rate of benzene decreased and desorption rate of deuterium as a decomposition product also decreased at elevated temperature.

On the other hand, hydrogen evolution increased even under C₆D₆ atmosphere at elevated temperature. In conclusion, a competitive chemisorption of benzene and water as a component of residual gas occurred and water adsorption on nascent steel surface was accelerated at elevated temperature.

The effect of temperature on chemisorption of organic compounds on nascent steel surface is also investigated.

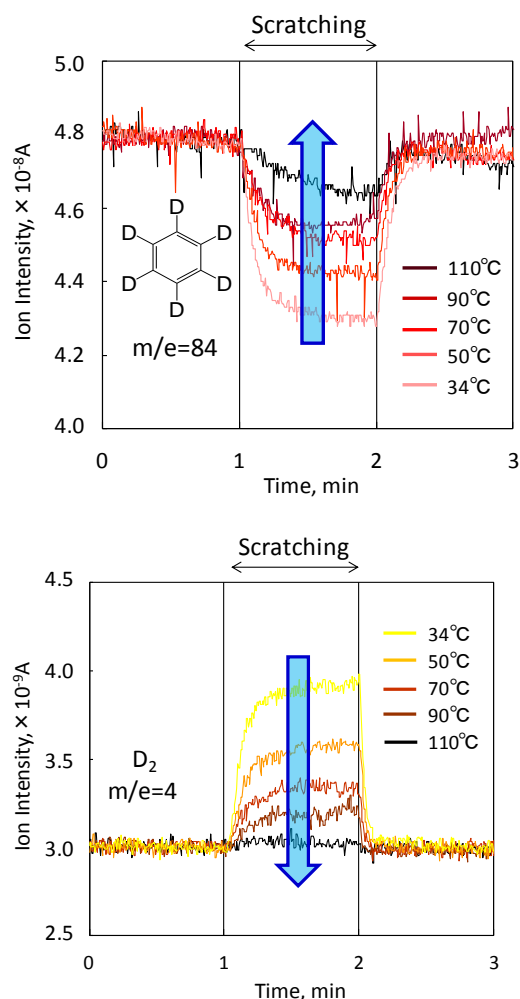


Figure 1 Effect of temperature on C₆D₆ adsorption and D₂ formation on nascent steel surface

4. Summary

It was found that the chemisorption of organic compounds on nascent steel surface is affected by temperature.

Acknowledgement

This research was financially supported by GRENE project of MEXT.

References

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