# Numerical Analysis of Micro-/Nanoscale Gas-Film Lubrication of Sliding Surface with Complicated Structure

Y. Kawagoe, S. Yonemura, S. Isono,

*Institute of Fluid Science, Tohoku University, Katahira 2-1-1, Aoba-ku, Sendai 980-8577, Japan*

and

T. Takeno,

*Graduate School of Engineering, Tohoku University, Aza-aoba 6-6, Aramaki, Aoba-ku, Sendai, 980-8579, Japan*

and

H. Miki,

*Frontier Research Institute for Interdisciplinary Sciences, Tohoku University, Aza-aoba 6-3, Aramaki, Aoba-ku, Sendai, 980-8578, Japan*

and

T. Takagi,

*Institute of Fluid Science, Tohoku University, Katahira 2-1-1, Aoba-ku, Sendai 980-8577, Japan*

Nakamori et al. [1] found experimentally that the friction between a partly polished diamond-coated surface and a metal surface was drastically reduced to zero as relative speed increased to a few m/s, and it seems that the diamond-coated surface took off the counter surface and the sliding mechanism was the gas film lubrication. Because of that the surface roughness of the diamond coated substrates is from 0.28 μm to 0.57 μm and the distance between two sliding surface will be in the order of surface roughness or smaller, Knudsen number *Kn* will be larger than 0.1. Therefore, micro-/nanoscale gas flows between two sliding surfaces cannot be treated as a continuum and we use the direct simulation Monte Carlo (DSMC) method [2].

In this study, to investigate the role of the gas flow for this phenomenon, we reproduce the complicated structure of the diamond-coated surface in the computational domain by using the data measured by an atomic force microscope (AFM), and perform numerical simulations of three-dimensional micro-/nanoscale gas flows. We reproduce the diamond-coated surface by using Marching Cubes method [3]. The computational domain is shown in Fig. 1. Fig. 2 shows the pressure distribution obtained in the DSMC simulation. In the case of Fig. 2, we obtained the lift force of $2.33\times10^3$ Pa, which is large enough to levitate the slider used in the experiment.

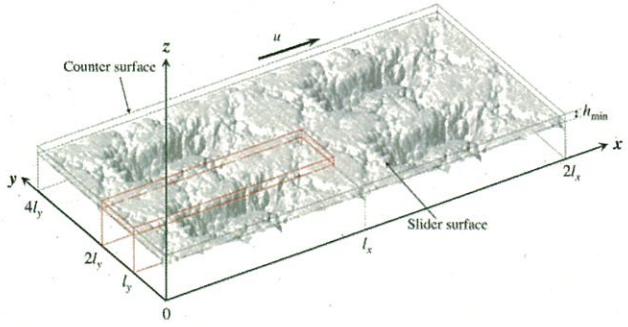


**Fig. 1 Computational domain.**

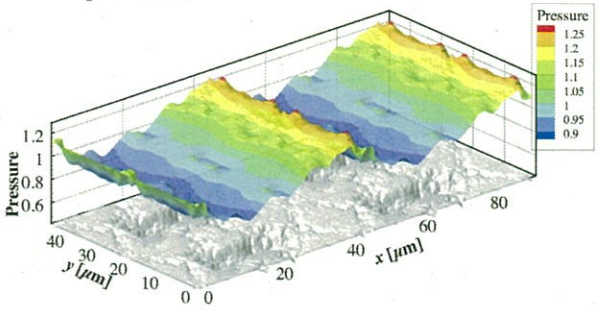


**Fig.2 Pressure distribution($u$=10 m/s, $R_a$=0.21 μm, $h_{min}$=0.028 μm).**

## REFFERENCES

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