Analytical Study on Liquid Transfer by Breakage of Liquid Meniscus Bridge

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1. Introduction

In the latest magnetic storage systems, the spacing between the flying head and the disk has been dramatically reduced to less than 5 nm for realizing ultra-high density recording. Lubricant on the disk is transferred to the flying head slider due to intermittent contact between the slider and the disk or due to condensation of lubricant vapor. The small amount of lubricant transferred to the flying head slider will affect the flying characteristics and the read/write performances[1].

In this paper, liquid transfer due to breakage of the liquid meniscus bridge was theoretically investigated. The liquid transfer volume was calculated by a balance equation of Laplace pressure and disjoining pressure.

2. Calculation of liquid transfer volume

A liquid meniscus bridge is formed between a sphere and a plane. The plane is covered with an ultra-thin liquid film. The liquid within the meniscus bridge is assumed to be supplied from the liquid film around the bridge. The effective radius of the meniscus shape is determined using a balance equation of Laplace pressure and disjoining pressure.

From Eqs. (1) and (2), the effective radius of the meniscus, \( r_{eff} \), is obtained as follows:

\[
r_{eff} = \frac{B - T}{3}.
\]

3. Calculation results

Liquid transfer volume as a function of the receding contact angle is shown in Fig. 2. It is found that the liquid transfer volume decreases as the receding contact angle increases. Additionally, the liquid transfer volume increases as the sphere’s radius of curvature increases.

4. Conclusion

Liquid transfer due to breakage of the liquid meniscus bridge was theoretically investigated considering a balance equation of Laplace pressure and disjoining pressure. The effects of the receding contact angle and the radius of curvature of the sphere on the liquid transfer volume are quantitatively clarified.

References