ASIATRIB 2002 International Conference
JEJU ISLAND, KOREA

The Effect of Slider Surface Texture on Flyability and Lubricant Migration under Near Contact Conditions

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Magnetron and Ion beam sputtering were used to texture the air-bearing surface of magnetic recording sliders. Flying height measurements and Laser-Doppler interferometry were used to compare the "flyability" of textured and untextured sliders. Lubricant redistribution on the disk surface caused by slider/disk interactions was investigated using scanning ellipsometry (Surface Reflectance Analyzer (SRA)). The results show that slider surface texture causes only small changes in the flying height of sliders but reduces slider in-plane and out-of-plane vibrations. Textured sliders were found to cause less lubricant depletion on the disk surface than untextured sliders.

Keywords : texture, slider, flyability, lubricant migration, near contact

1. INTRODUCTION

To increase the recording density of hard disk drives, the flying height between slider and disk must be reduced. In order to achieve a recording density of 100 Gb/in2, it has been suggested that the flying height of a slider would need to be about 6 to 7 nm [1]. Textured sliders have been suggested to improve the tribological performance of sliders with very smooth disk surfaces [2-4]. The present work deals with the effect of slider texture on the head/disk interface. Slider/disk interactions are studied when the slider is flying over the disk surface with a flying height that is less than 10nm. Magnetron sputtering and ion beam sputtering are used to create texture on the slider air-bearing surfaces. We first investigate the "flyability" of textured and untextured sliders using monochromatic interferometry and then use Laser-Doppler Vibrometry (LDV) to investigate the in-plane and out-of-plane motion of the slider. Finally, the effect of slider surface texture on lubricant depletion on the disk surface is studied using scanning ellipsometry (Surface Reflectance Analyzer (SRA)).

2. Experiments

The texture on the slider surface was fabricated using ion beam etching (Fig.1). A commercially available flying height tester (DFHT) was used to measure the flying height of the sliders before and after texturing as a function of velocity. A Laser Doppler Vibrometer (LDV) was used to observe the in-plane and out-of-plane vibration modes of the sliders as a function of flying height.

The textured and untextured sliders were investigated on Z-dol 4000 lubricated disks with lubricant thickness of 1.5nm, 2.5nm and 3.5 nm, respectively. All disks exhibited an arithmetic roughness of 0.8nm (Ra). After each test, the disks were observed with the Surface Reflectance Analyzer (SRA) to measure the change of lubricant thickness in the slider "wear" tracks.

3. Results

Texturing of sliders causes only minor changes in the flying height versus velocity characteristics of a slider (Fig. 2). Slider surface texture reduces slider in-plane and out-of-plane vibration modes under near contact conditions (Fig. 3 and Fig. 4). Slider surface texture reduces lubricant depletion on the disk surfaces under near contact conditions. Disks with thick lubricant layers showed more lubricant depletion for sliders flying at a flying height less than 10nm than disks with a thin lubricant layer (Fig. 5).

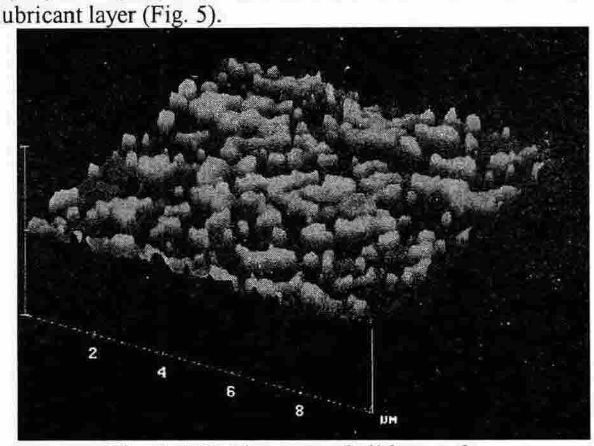


Fig. 1 AFM images of slider surface

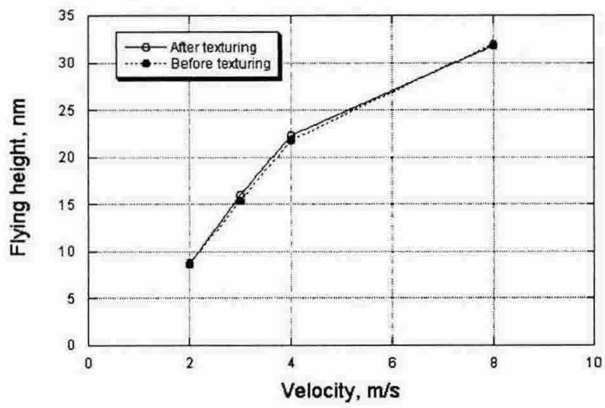
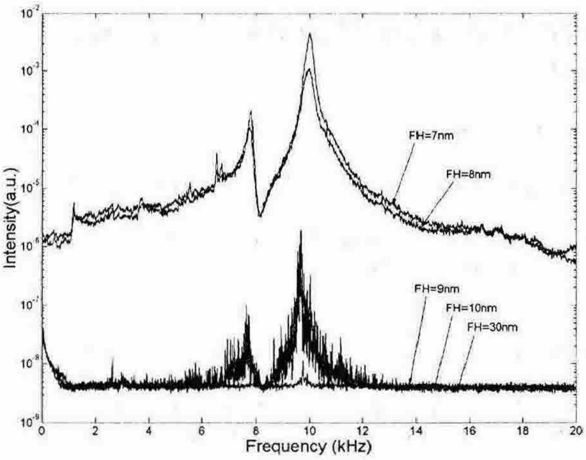
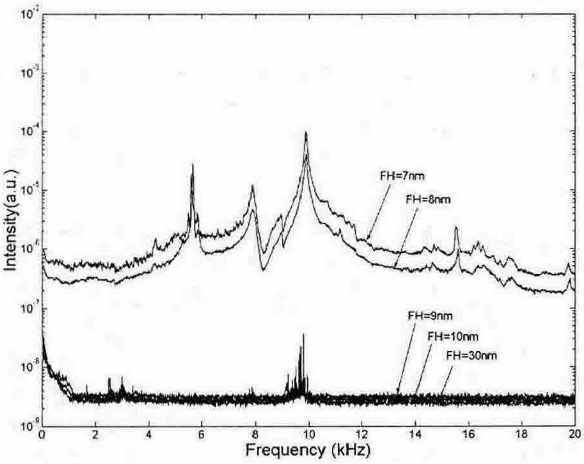


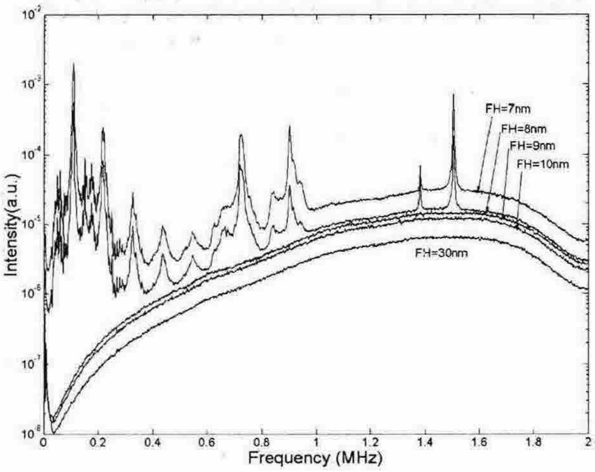
Fig. 2 Flying height versus disk velocity before and after etching



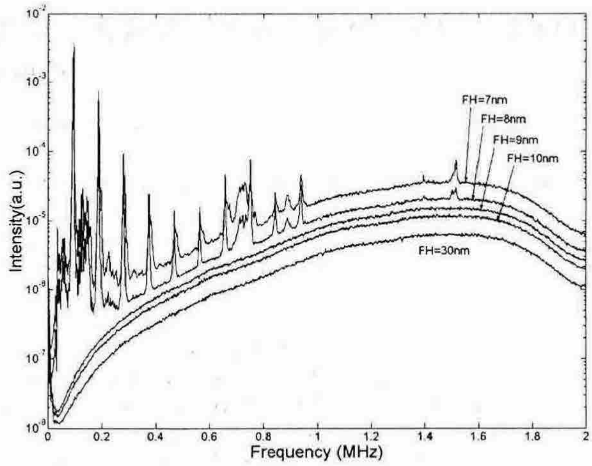
(a) untextured sliders



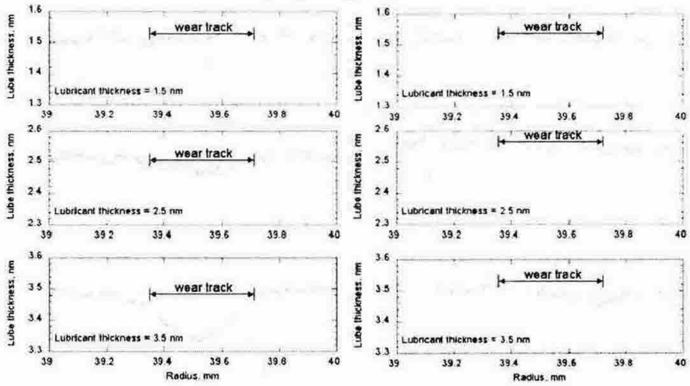
(b) textured sliders
Fig. 3 Spectrum of Slider in-plane motion as a function of flying height



(a) untextured sliders



(b) textured sliders
Fig. 4 Spectrum of Slider out-of-plane motion as a function of flying height



(a) untextured (b) textured
Fig. 5 Average lubricant thickness across wear tracks

4. Conclusions

Based on the results obtained in this study, it appears that texturing of sliders is a promising way to improve the performance of the head/disk interface.

5. References

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