A SLIDER WITH AN INTEGRATED MICROACTUATOR (SLIM) FOR SECOND STAGE ACTUATION IN HARD DISC DRIVES

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Introduction

With increasing recording density of Hard Disc Drives (HDD), the distances between flux reversals as well as the width of the magnetic data track decrease. To increase the first one, a dynamic reduction of the head-to-disc spacing during writing and/or reading is desirable and has been implemented into latest generation recording heads. Track following is accomplished by rotary voice coil actuators positioning the recording heads on the required data track. The head itself consists of a suspension mounted to the actuator on one side and carrying a slider, which "flies" over the disc and contains the read/write element, on the other side. These actuator systems run into limitations in regard to track following, posing a handicap for further increasing the radial (track) density. To resolve this issue, a second stage actuator may be integrated in the read/write head to accomplish more accurate and higher frequency track following than possible with existing actuators [1, 2]. Concepts for the design of such actuators are known. However, since the HDD industry is extremely price sensitive, it could not convince itself to accept additional cost even for the sake of a performance increase.

Second Stage Actuation Concept

For coming up with a cost competitive solution for second stage micro actuation, the following approach is taken. A slider with an integrated microactuator (SLIM) allows both vertical (for head-to-disc spacing adjustment) and lateral (for fine tracking) motion of the read/write element. The read/write element is part of a chiplet, which requires only a fraction of the wafer real estate required for fabricating a present slider containing the read/write element. Therefore, SLIM is a solution that not only provides the required actuation capabilities, it also allows its fabrication at lower costs than a present slider [3].

SLIM Design

Figure 1 depicts the SLIM design. SLIM is a two-part design and is fabricated on two separate wafers. The actuator magnetics are located in the bottom part of the device and consist of a pair of active parts. The actuator mechanics are situated in the upper part. A mounting platform suspended by a pair of leaf springs carries a chiplet containing the read-write element. Figure 2 depicts the simulation results for magnetic forces of a single actuator system. A simultaneous excitation of both active parts lowers the chiplet to its flying height position, while an alternative excitation of the two active parts causes a minute rotation of the chiplet and thus a lateral displacement of the read/write element, allowing a micro positioning for track following. A desired lateral displacement of ±625 nm results in a rotation of 0.18°. For the micro actuation to function, both the slider body and the chiplet are equipped with air bearing surfaces (ABS), which are coated with a thin DLC (diamond like carbon) layer.

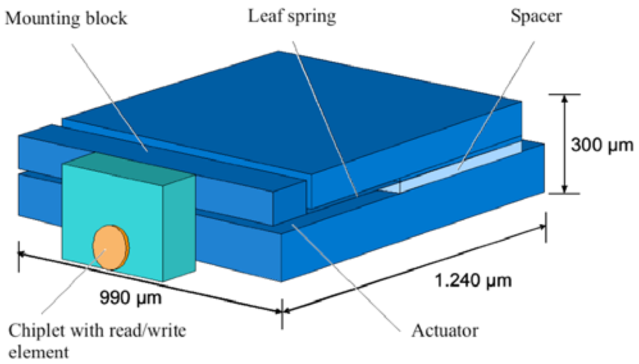

Figure 1 Slider with Integrated Microactuator (SLIM).

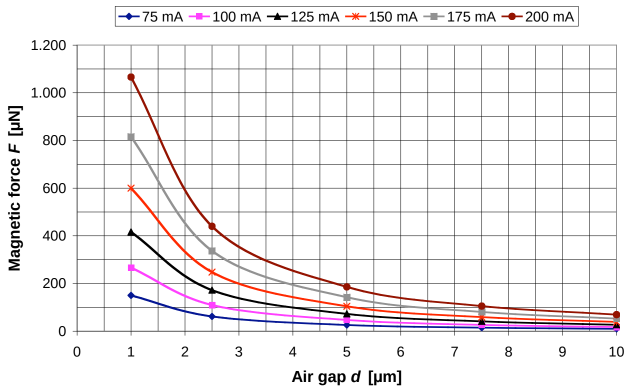

Figure 2 Simulation results for microactuator forces

For fabricating SLIM, a thin-film batch fabrication approach is taken, fabricating the actuator magnetics and mechanics on two separate silicon wafers. Since the energy a microactuator is able to transduce is proportional to its volume, high aspect ratio micro system technologies (HARMST) are applied. Actuator mechanics are fabricated using MEMS processes and as a base material utilize single crystalline silicon. The suspended platform which carries the read/write element is realized by sacrificial layer technology and DSE (deep silicon etch). The two cantilevers of the platform consist of polysilicon that is deposited by LPCVD and doped in a following process. System integration of the SLIM device is accomplished by bonding the top wafer to the bottom wafer. The two main challenges are developing an appropriate spacer technology and to come up with a suitable bond technology.

Program Execution

For executing the SLIM development, the Leibniz Universitaet Hannover (concept and magnetics design) has teamed up with the Berlin University of Technology (silicon micromachining), INESC, Lisbon, Portugal (test design), and Cambridge University (DCL coating and tribology). The program is funded by the EC within the Sixth Framework Program by Information Society technologies within the Specific Targeted Research Program (STREP) “Performance Advances in Recording through Micro Actuation” (PARMA).

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