Magnetic Storage Devices:

Difference in Hardness of Head Slider Phases

Ashok Kulkarni, Ph.D.

The read/write capability of computer disk drives requires the relative motion of a magnetic media and a read/write magnetic head. Physical contact between the media and the head occurs during loading and unloading cycles. Tailoring the mechanical properties of the media and the head has become critical in order to minimize damage and loss of data. This application note is focused on the mechanical properties of the head slider.

The tested head sliders are composed of an Al_2O_3 – TiC composite with a thin 10 – 20nm diamond-like-carbon protective overcoat. As shown in Figure 1, the slider surface is composed of two phases, Al_2O_3 and TiC. The Hysitron TriboScope® was the first instrument to report hardness differences for two material phases used in head sliders. The TriboScope® is a quantitative depth sensing nanoindenter that can be interfaced with a scanning probe microscope to provide *in-situ* imaging.

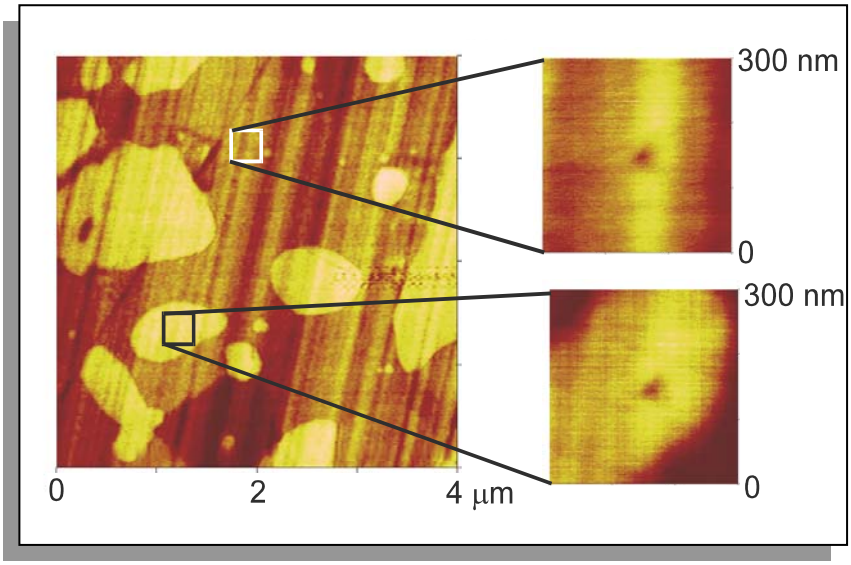

Figure 1: Hysitron TriboScope® image of the surface of a head slider showing the TiC phases (light areas) and the Al_2O_3 phases (dark areas). Two indentations are shown, one in the TiC phase and one in the Al_2O_3 phase. Both indentations were performed at a maximum applied force of 50μN.

This imaging capability distinguishes between phases in a composite material, making it possible to select the phase in which the indentation is to be performed. Once the indentation is performed, the surface is imaged a second time to characterize the indent. The applied force and the penetration depth of the indenter into the surface are measured simultaneously. The hardness is determined from this data.

Figure 1 is a TriboScope® image of the slider surface. The lighter regions in the image correspond to the TiC phase while the darker regions can be attributed to the Al_2O_3 phase. The insets in Figure 1 show the indentations made in each phase. Both indentations were performed at the same peak applied force of 50μN.

Figure 2 shows the force-displacement data obtained by indenting the TiC and Al_2O_3 phases at a maximum applied force of 25μN. Reversibility of the loading (dark blue) and unloading (light blue) curves indicates elastic deformation at the TiC phase. Therefore, no indent is left on the surface.

Hardness values were derived for both material phases, and were 29 GPa for the TiC phase and 25 GPa for the Al_2O_3 phase, respectively.

Conclusion:

The Hysitron TriboScope® was used to measure the hardness of each phase of a head slider. The measured hardness values were 29 GPa for the TiC phase and 25 GPa for the Al_2O_3 phase.

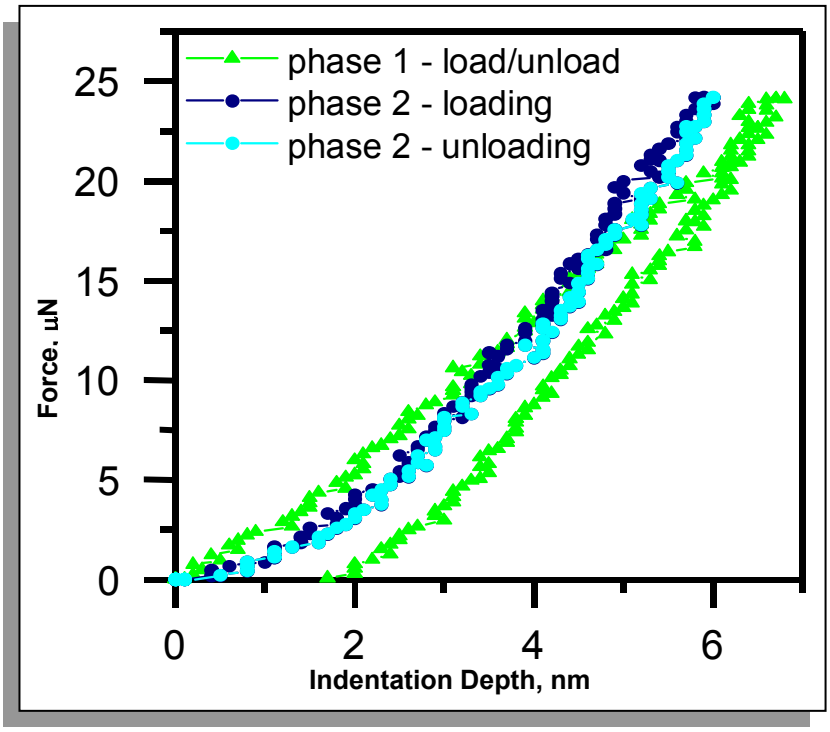

Figure 2: Force-displacement data for an indent into the TiC and Al_2O_3 phases of the head slider shown in Figure 1. The hardness of each phase was measured from this data. The indentation into the TiC phase was elastic as shown here by the reversibility of the loading (dark blue) and unloading (light blue) curves. No permanent indent was left on the surface after acquiring this curve.

World Leader in Nanomechanical Test Instruments
Hysitron Incorporated

10025 Valley View Road
Minneapolis MN 55344
Tel: (1) 952.835.6366
Fax: (1) 952.835.6166
info@hysitron.com
www.hysitron.com