Microcracks of the Thin-Film Head Alumina: "L" cracks and "U" cracks

A.S. Chekanov, T.S. Low, S. Alli
Data Storage Institute, National University of Singapore, Singapore

O.Kolosov, A.Briggs
Department of Materials, Oxford University, UK

***Abstract*--Two different types of microcracks in thin film head alumina were observed : cracks initiated at the alumina edges growing toward the head pole tips and cracks initiated at the head pole tip area and growing towards the leading edge of the alumina. Thermally induced cracks may cause degradation of magnetic head read/write performance due to the damage of the pole tip gap or corrosion of the head pole tips. Data from Ultrasonic AFM (UFM) indicate the difference in the subsurface structure of the observed cracks of the alumina.**

I. INTRODUCTION

In our previous study of microcracks of the thin-film head alumina [1] using the AFM (Topometrix 'Accurex' SPM), we observed the initiation and growth of the microcracks due to the fatigue process in the alumina. This is caused by the cumulative action of the cyclic thermal expansion-contraction of the head material and mechanical shocks experienced by the head during intermittent contacts with the rotating disk surface[1]. The AFM topography image of this type of crack (Fig.1) indicates that it is growing toward the head pole tips. The crack often propagates through the head gap, resulting in a magnetic head recording field distortion [1]. We will refer to these types of microcracks as "L"cracks. A different type of crack observed here is initiated at the head pole tips and grow toward the leading edge of the alumina ("U-cracks") (Fig.2a). One can see that the topography of the U-crack is similar to the shape of the upper part of the underlying magnetic head yoke; it could also be related to alumina inhomogeneities (Fig. 2b) typically observed at this area.

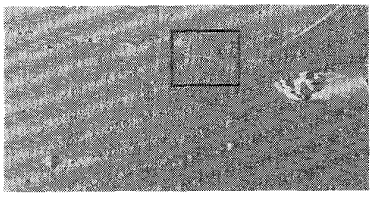
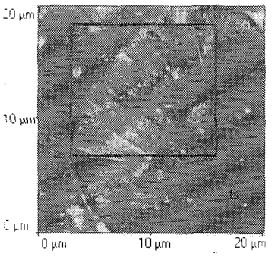


Fig 1: AFM topography image shows "L" crack propagating through the head pole tip gap. The rectangle indicates the pole tips area .



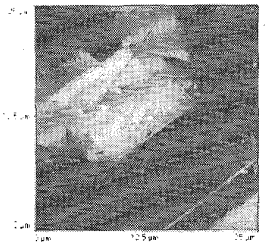


Fig 2a (left) : AFM topography image showing a 'U' crack growing from the pole tips to the leading edge. Pole tips are located within the square.
Fig 2b(right): Inhomogeneities seen in the alumina around the pole tips.

In this paper we discuss the origin of the observed defects of the thin-film head alumina and their effects on the performance of the magnetic head.

II. EFFECTS OF MICROCRACKS ON THE READ--WRITE PERFORMANCE OF THE MAGNETIC HEAD.

The read/write performance of a head with a crack propagating through the head pole tip gap was studied using a Guzik 1701 spin-stand. Comparison of the read/write performance of selected pristine magnetic head (TPC 50 % slider) and of the same head after "L"-crack simulation (Fig.3) shows that there is a severe decrease of the Track Average Amplitude (TAA). This effect is more pronounced at the inner diameter area of the magnetic disk where the TAA is reduced by about 50% for a cracked head as compared to the pristine head. The Pulse Width (PW_{50}) increases (Fig 4) and is about 20% higher for the head with the crack. The degradation of the magnetic head read/write

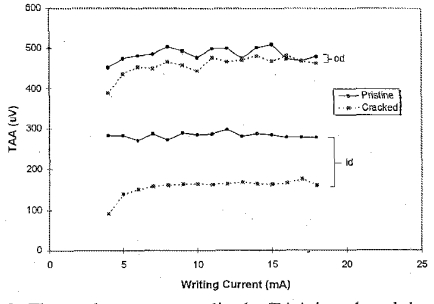


Figure 3: The track average amplitude, TAA is reduced due to the presence of the crack at all positions on the disk.