RELIABILITY ENHANCEMENTS IN HARD DISK DRIVES USING IN-SITU VAPOR PHASE ADDITIVES

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Introduction and Experimental Results

Several design measures are put in place to assure that the immediate operating environment around head-disk interfaces are maintained at high levels of cleanliness. While considerable attention to both manufacturing practices as well as design variables have always been in place, such precautions are becoming especially important for drives that are manufactured today as well as those planned for the future.

As is widely known, the head-disk spacing currently is on the orders of a few nanometers and extremely small amounts of extrinsic contamination have critical consequences for drive reliability. Chief among these are organic smears which accumulate on slider surfaces affecting designed flying height as well as the ingestion of hard and soft particles into the interface which can cause scratches or smears on media and slider surfaces. Hydrocarbon contamination from components used in the drive, such as the actuator assembly or motors, can potentially collect on slider surfaces presenting another complication to achieving reliability targets. It is increasingly apparent that the traditional design measures needs to be augmented by additional counter measures, preferably within the disk drive environment, in order to maintain existing levels of reliability.

In this paper, we describe efforts to develop in-situ HDD schemes to limit the formation of a typical organic smear, such as siloxanes, on sliders using a commercially available anti-oxidant. It is well known, over several decades of work, that the formation of these smears presents considerable problems for interface reliability. Our initial hypothesis was that the conversion of Polydimethylsiloxane (PDMS) into SiOx smears involved an oxidation process. We surmised that the intentional inclusion of an anti-oxidant could be beneficial in arresting or mitigating the oxidation process and prevent the collection of smears on slider surfaces.

In addition, we present experimental results to demonstrate that collection of hydrocarbon liquids on sliders, potentially leading to poor writes, may be mitigated by including a source of low molecular weight perfluoropolyether (PFPE) liquids, such as Z-dol inside the disk enclosure. As is well known, disk surfaces are covered with a thin film of a topical lubricant and these surfaces present large surface area to potential contaminants for adsorption. We surmised that the relative incompatibility between PFPE coated surfaces and hydrocarbon liquids could be engineered in a manner so as to prevent the collection of hydrocarbon liquids in sensitive areas of the slider. Several other perfluoro compounds have also been investigated with good efficacy against collection of hydrocarbon liquids on sliders. Although the details involved in limiting siloxane smear formation and the collection of hydrocarbons on sliders appear different, these methods potentially point to being able to develop viable schemes to protect the slider from contamination buildup during long term operation. We discuss results from these sets of experiments and discuss the fundamental mechanisms involved. These approaches provide additional insights into the tribology of head-disk interfaces and provide impetus to look for novel strategies to improve reliability.

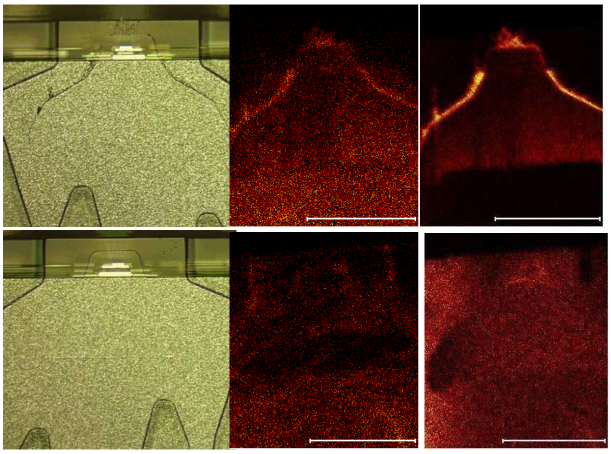

Fig. 1: Trailing edge of slider surfaces showing silicon smears and its absence after flyability tests with the inclusion of an anti-oxidant in the disk enclosure.

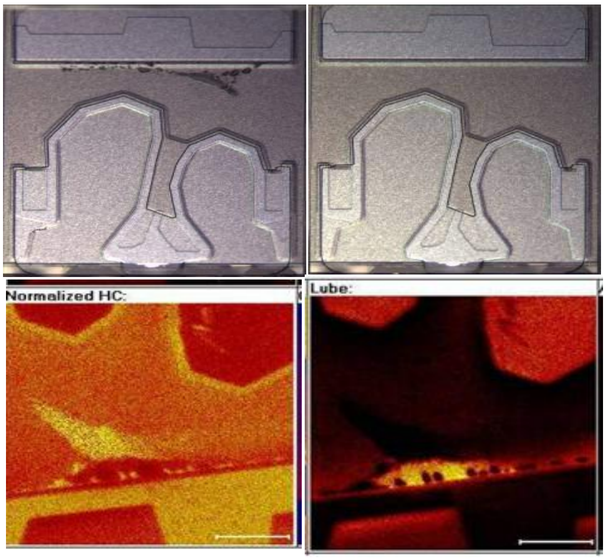

Fig. 2: Sliders showing collection of hydrocarbon liquids and its absence with a Z-dol source within disk enclosure.