Protection of GMR Heads in Tape Environments

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Motivation
GMR heads are observed to fail quickly in tape environments
When two dissimilar metals are in contact with each other, an electrolyte, and air
One metal is oxidized
The other catalyzes oxygen reduction
One means to protect metals against corrosion is to prevent water from adsorbing to the metal surface

Project Objective
To discover methods to protect GMR heads used in magnetic tape against erosion, corrosion and electrostatic discharge in tape environments

Approach
An ultrathin coating of an amine-quinone polymer on the head
A thin (monolayer) of an amine-quinone species is chemisorbed to the surface of the GMR head
The amine-quinone monolayer blocks moisture adsorption
The thickness is 1 to 2 nm, to minimize spacing loss
Also serve the role of the lubricant
Is replenished from the tape

Experimentation
Demonstration that amine-quinone polymers can protect GMR heads against corrosion
Electrochemical experiments using the GMR heads as an electrode
Polarization curves
Electrochemical impedance spectroscopy
Surface spectroscopy to determine the modes of corrosion protection
X-ray photoelectron spectroscopy
FTIR
Raman
High resolution electron microscopy

Test Specimen
We will demonstrate whether amine-quinone polymers can protect the individual metals used in GMR heads against corrosion
Sputter deposit a metal film on a suitable substrate
Cu, Co, Ru, FeCo, NiFe, Pt, Mn, IrMn, any others?
Chemisorb an amine-quinone species onto the metal from and organic solvent
Use reflectance IR and x-ray photoelectron spectra to confirm the presence of the amine-quinone species and gain insight into the mode of bonding to the metal surface
Polarization curves will demonstrate the ability of the amine-quinone species to prevent corrosion

Multiple Metal Stacks
Specimen consisting of multiple metal layers, (colored layers) on a substrate (gray layer) covered by a mask (black layer)
Chemisorb the amine-quinone species to the exposed metal stack
Polarization curves determine the ability of the amine-quinones to protect a metal stack against corrosion
Electrochemical impedance spectroscopy to study the corrosion of the stack in the presence of aqueous, aerated NaCl electrolyte

Amine-quinones Prepared for this Project

Accomplishments
We have revived the amine-quinone polymer project
An undergraduate student has
Learned how to make amino-quinone monomers and polymers
Learned how to sputter thin metal films

Plans
Hire a post doc to accelerate the project

Protecting GMR Heads Against Erosion
Very thin, highly cross-linked, hard organic coating on the metal surface
Use the Nanolndenter to measure the hardness of the coating
Eliminate the wear particles in the tape, giving ultra-smooth surfaces.

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