Improved Embedded Alumina Defect Performance through a Multi Particle Slurry for Hard Disk Polishing

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Presentation Outline

• Industry memory requirement trend
• Some problems due to embedded alumina defects
• Defect formation mechanism
• How to minimize embedded alumina defects on Ni-P surfaces?
• Conclusions
Higher field densities are desired by HDD technology road map.
Embedded Alumina Defect Challenges

1. Low S/N ratios
2. Obstruct slider motion above substrate surface
3. Distortion in magnetic field in defect region
Embedded Alumina Defect Formation Mechanism

- 1\textsuperscript{st} step slurry in HDD substrate polishing is the only alumina source to cause embedded alumina defects
- Embedded alumina is seen either at post 2\textsuperscript{nd} step defect review or at device failure
- Sharp edges of alumina gets embedded into Ni-P layer, leaving fractured particle(s) inside surface film
- Particles still resides in film after P2 polish
- Subsequent process steps magnifies the presence of the embedded particle
- Methods such as FIB, FESEM, and SEM – EDX reveal the defect type to be Al\textsubscript{2}O\textsubscript{3}

Irregular shape alumina in slurry
Multi Particle Slurry for Low Embedded Alumina

1. Large Alumina
2. Small Cabot Alumina
3. Colloidal Silica
4. Complexing agent
5. Oxidizer
6. Additive at Point of Use
Alumina-Silica Interaction Mechanism

Electrostatic attraction between alumina and silica particles leads silica to coat around alumina.

Zeta potential: +80eV @ pH 2-3
Zeta potential: -20eV @ pH 2-3

Silica – Alumina nano particle halos
Solution for Embedded Alumina

US Patent 6,896,591 B2

Irregular shape alumina
0.1um – 0.9um

Regular shape alumina
0.05um – 0.4um

Alumina coated with Silica

HR – SEM image revealing Alumina coated with Silica

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Candela Defect Maps after 2\textsuperscript{nd} Step Polish

- Pure alumina 1\textsuperscript{st} step slurry polish disks give higher particles on disk surface. Defects maps were taken after P2 polish process.
Conclusions

• Due to opposite surface charges on alumina and silica, silica particles get coated around alumina in slurry media

• Silica particle coating around alumina makes the substrate - particle interaction less severe to prevent embedded alumina defects
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