ALTERNATIVE SUBSTRATE MC-21 COMPOSITE ALLOY WITH LN3—COMPETITION FOR GLASS?

Dr. Leonard Nanis, LN3 Electrochemical Engineering

Dr. Tom Coughlin, Coughlin Associates

MC-21 Composite Alloy

MC-21 composite alloy is an aluminum matrix strengthened by microscale silicon carbide particles. MC-21 is produced by the MC-21 Corporation, Carson City, Nevada. MC-21 substrates can be used for very high RPM disks for fast data access.

Table 1. Comparison of properties of MC-21, aluminum and glass

Material	Modulus of Elasticity (25 C) (GPa)	Modulus of Elasticity (25 C) (Mpsi)	Density (gm/cc)
MC-21 30 vol% SiC	138	20.0	2.80
Glass	105	15.2	2.65
Aluminum (5086)	71	10.3	2.66

Useful properties of MC-21:

- •Resists deformation with a modulus of elasticity twice that of aluminum.
- •Rapid damping minimizes oscillations, reducing tracking errors.
- •Using the LN3 sputter seed layer standard electroless Ni-P plates readily

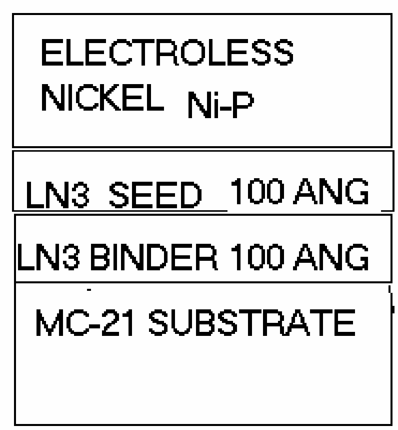
LN3 Seed Layer for MC-21

The conventional wet zincate pre-treatment during plating only works on aluminum (not silicon carbide) and etches and roughens the surface. Thus wet zincate pre-treatment creates pits and nodules in the resulting Ni-P layer.

LN3 seedlayer permits thick Ni-P plating on both silicon carbide and aluminum without wet zincate pre-treatment. Conventional electroless plating directly on the LN3 seedlayer avoids the creation of nodules and pits.

Figure 1 shows the structure of an LN3 coated MC-21 disk. The LN3 sputter deposited binder and seed layers cover all phases in the MC-21 surface. The binder layer promotes good adhesion. Other advantages of LN3 are that no other pre-treatment is needed; elapsed time between LN3 and Ni-P can be 3 months. The resulting Ni-P layer covers 100% of the surface. A smooth substrate results in a smooth Ni-P layer so polishing can be reduced.

Figure 1. Structure of LN3 MC-21 Disk



Comparison of MC-21 with conventional zincate pre-treatment & LN3

Figures 2 and 3 show SEM photographs at 400 X of a conventional zincate pre-treatment MC-21 surface and an LN3 seed layer MC-21 surface respectively. Both surfaces have a one hour long deposition of electroless Ni-P. Note that the LN3 coated disk has no nodules or pits and is a totally conformal coating.

ALTERNATIVE SUBSTRATE MC-21 COMPOSITE ALLOY WITH LN3—COMPETITION FOR GLASS? (2)

Figure 2. MC-21 (30 vol% SiC) with conventional zincate pre-treatment and a Ni-P plated layer showing nodules and a deep pit at a SiC particle.

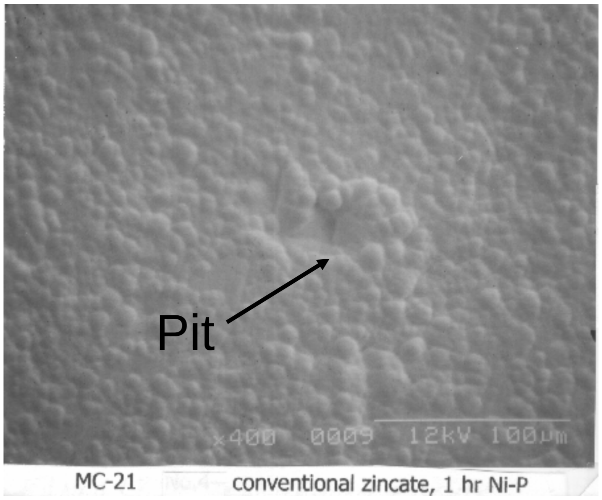
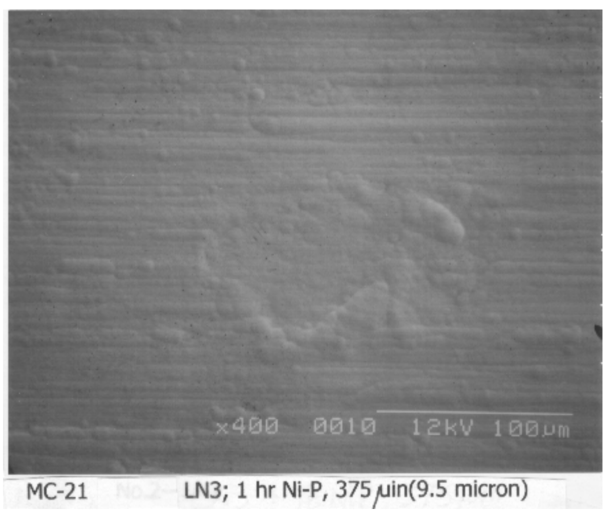


Figure 3. MC-21 (30 vol% SiC) with 9.5 micron (375 microinch) LN3 and a Ni-P plated layer showing original surface topography.



Cost Analysis

For a magnetic layer deposition ready Ni-P plated and polished MC-21 substrate (65-mm, 3-5 million units per month, stamped MC-21 rolled sheet, flatbaked, chamfered, surface ground, LN3 sputter, NiP plate, two-stage polish) the cost is about ***$0.84 ($0.76 to $0.95)***.

Additional conditions for this cost calculation:
•92.2% overall yield.
•Sputtering machine cost: $750k-$1.25M.
•Sputter throughput 1,500-2,000 per hour.
•Seed target cost $2,000 to $4,000.
•LN3 binder layer thickness 100 Angstrom.
•LN3 seed layer thickness 100 Angstrom.
•NiP plate layer thickness 300 microinches.
•First polish 50 microinch removed.
•Second polish 25 microinch removed.

LN3 on other substrates

In addition to MC-21, the LN3 seed layer with electroless Ni-P has been successfully applied to many other materials that cannot be activated by the conventional zincate pre-treatment, including glass, carbon and boron carbide.

Excellent magnetic performance has been demonstrated for finished disks with LN3 seed layer and electroless NiP using 5586 Aluminum alloy substrates.

References

1)L. Nanis, US Patent 5,405,646, “Method of Manufacture of Thin Film Magnetic Disk,” April 11, 1995.
2)L. Nanis, US Patent 6,986,956, “ Method of Coating Smooth Electroless Nickel on Magnetic Memory Disks,” January 17, 2006.
3)L. Nanis, “Sputter Seeded Nucleation of Smooth Electroless Nickel Growth,” Plating and Surface Finishing, Nov. 2005, pp. 27-31.

Appendix: Comparison of Current Aluminum Substrate and LN3 Substrate Disk Production Processes