NANO HIGHLIGHT
Nanomasking with Nanoparticle Arrays

NSF NIRT Grant ECS-0507050
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Magnetic disk drive technology has successfully reduced the size of multi-grain bits to ~30 nm 30 nm × 100 nm across, and there are intensive industrial efforts to shrink the bit size further. There has been great interest in patterned media, where arrays of isolated magnetic marks are read and written individually. However, lithographic fabrication costs are extremely high. The nanomasking process has the potential to lower manufacturing costs in self-assembled nanostructures.

The nanomasking approach takes advantage of self-assembly to prepare patterns on a length scale much smaller than can be achieved with electron beam writing, and it is a massively parallel, rather than serial, fabrication process. The change in the surface morphology expected from ion milling is schematically illustrated in Figure 1. To accomplish this, self-assembled nanoparticle arrays are transferred to the substrate to be patterned (in this case Co/Pt multilayers). The pattern of the nanoparticle cores must then be transferred into the underlying multilayers. In the case of magnetic materials, unlike with silicon, there are no suitable reactive etchants that yield gas phase species, and therefore ion milling was used. However, reactive ion etching may be suitable for nanomasking semiconductors.

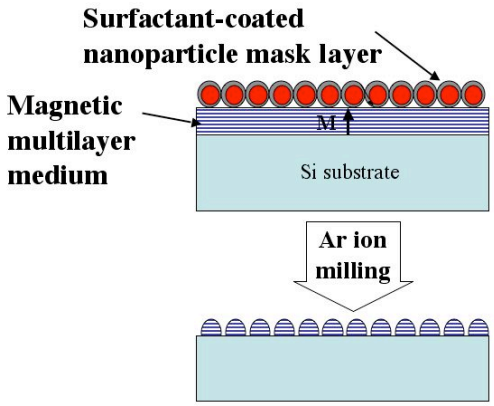

Fig. 1. The nanomasking process: (a.) a crystallographically oriented magnetic multilayer structure (here Co/Pt) is grown on a Si substrate; (b.) a self-assembled nanoparticle array (here 8 nm Co or Fe_3O_4) is transferred to the metal surface by the Langmuir-Schaefer method; (c.) UV irradiation to removes the organic surfactant (gray), so that gaps appear between particles but the order is preserved; and (d.) argon ion milling transfers the pattern of height variations into the underlying multilayers.

References

[1] For further information about this project link to http://www.andrew.cmu.edu/user/sm70/index.html or http://info.phys.cmu.edu/people/faculty/Majetich/ or email **sara@cmu.edu**
[2] M. Sachan, N. D. Walrath, S. A. Majetich, K. Krycka, and C.-C. Kao, *J. Appl. Phys.* **99**, 08C302 (2006).