

# **UNH Materials Science Seminar**

11:00-12:00, Thursday, October 14, 2004

DeMeritt Hall 209B

University of New Hampshire

## **TEM of Epitaxial Thin Films Controlled by Planes Extending (near) Normal to the Interface**

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This work studies heteroepitaxial interfaces as applied to multilayer thin films for magnetic information storage media. With a goal to develop a film crystallography that optimizes the alignment of magnetic dipoles to coincide with the write/read signal of the recording head, two TEM observations have elucidated a better understanding of what controls heteroepitaxial interfaces. The classical approach to establishing "lattice matching" of interfaces is to model the top plane of atoms of the substrate and then align the next plane of atoms in the subsequently deposited film. Such a mechanism is valid for slow MBE growth where the planes remain flat. However, most deposition conditions violate this atomically flat configuration. Growth on roughened interfaces is shown to be controlled by the matching of planes that extend (normal or near-normal) across the interface.

A second classical observation is the nucleation of bi-crystals, which naturally increases the number of crystal orientations in subsequent films. However, this work exhibits two cases of reducing orientations! One case has a 3-D isotropically oriented cubic film followed by a hexagonal film with 2-1/4-D isotropy, and a second case where a 2-D random cubic film is followed by a hexagonal film with 1-1/2-D isotropy. The control of these heteroepitaxial interfaces enables reduction of film orientations to enhance properties such as 100 Gigabit per-square-inch magnetic recording.

Warren MoberlyChan is a Lecturer in the Division of Engineering and Applied Sciences at Harvard University, and a staff member of the Center for Imaging and Mesoscale Structures (CIMS). His background is materials characterization, with a specialty in failure analysis and metrology. And he has been operating electron microscopes for over 25 years. He has worked in several academic labs, including Stevens Institute and Lawrence Berkeley Labs. His educational background includes an Engineering Degree from Brown University, and a Masters and PhD in Materials Science & Engineering from Stanford University. He has worked for several industries, ranging from hard drives (Quantum, Komag, and Read-Rite) to aerospace to oil drilling. His research has included shape memory materials, magnetic thin films and structural high-temperature ceramics. His accomplishments include directing a team that produced the world's toughest Silicon Carbide; and implementing an automated cleaner in Japan's premier hard-drive manufacturing line with a goal to meet the Montreal Protocol for Freon abatement. This latter experience taught him that cleaning is paramount to materials science, that contamination is everywhere even in cleanrooms and vacuum systems, that controlling contamination improves materials, and the first step is to find and analyze contamination and defects by microscopy.