Carnegie Mellon

Materials Science and Engineering Seminar Series

Materials Research at Carnegie Mellon

Hua Yuan

Graduate Research Assistant
Department of Materials Science and Engineering
Carnegie Mellon University

"Composite Metal-Oxide Thin Films for Applications in High Density Data Storage"

Friday, January 23rd, 2009
11:30 A.M. Seminar in Baker Hall 136A

Composite metal-oxide thin films are a new area of study in many applications. Engineering the processing, microstructure and properties of these thin films are of great importance. In high density recording media application, it has been found that composite granular Co alloy + oxide thin films exhibit very high perpendicular anisotropy and good recording properties. The microstructure of these films is mainly composed of fine (~ 8-10 nm) magnetic grains physically surrounded by an oxide phase. This produces magnetic isolation of the grains. Interlayers (e.g. Ru) and seedlayers play an important role in the perpendicular magnetic recording media, because they are utilized to control the texture, microstructure and grain size of the magnetic layer. An important hypothesis is based on the assumption that smaller grain size media can be obtained by means of using composite interlayers and seedlayers with smaller grain size. It has been found that microstructures of composite Ru + oxide interlayers are a strong function of oxide volume fraction and sputtering gas pressure. Surface diffusion and shadowing effect are found to play an important role in determining the various thin film microstructures under different processing conditions. This induces the four characteristic microstructure zones to be distinguished: "percolated-type"(A), "maze-like type"(T), "granular type"(B) and a microstructure with metal crystals embedded in the amorphous matrix (C). Thus, a new microstructure diagram of composite thin films has been proposed based on the experimental observations. The sputter deposited composite Ru + oxide interlayers were found to maintain the strong perpendicular (00.2) texture and have much smaller grain size. The Co alloy + oxide magnetic layers grown on top of these interlayers were found to have reduced grain size and maintain the (00.2) texture as well by means of template growth. Magnetic properties of the media of various grain sizes follow the theoretical model of grain size dependent coercivity formula.

Hua received her Bachelor degree in Materials Science Department from Fudan University, China in 2005; and her Master degree in Materials Science and Engineering Department from Carnegie Mellon University in 2006, respectively. She is currently a Ph.D. candidate under the guidance of Prof. David E. Laughlin.