Scanning electron microscopy with spin polarized electrons (invited) (abstract)

J. Unguris, G. G. Hembree, R. J. Celotta, and D. T. Pierce
National Bureau of Standards, Gaithersburg, Maryland 20899

The recent joining of scanning electron microscopy and electron spin polarization analysis has greatly improved the ability to study magnetic microstructure.[1,2] By measuring the spin polarization of secondary electrons, scanning electron microscopy with polarization analysis (SEMPA) can directly measure the magnitude and direction of the magnetization and direction of the magnetization in the region probed by the incident electron beam. This region is defined by the diameter of the incident electron beam (~ 10 nm) and the escape depth of the secondaries (~ 5 nm). In addition to the purely magnetic image SEMPA also simultaneously and independently measures the usual topographic image, thereby making comparisons between magnetic and topographic structures easier. We have successfully used SEMPA to study magnetic structures in Fe crystals, permalloy films, CoNi recording media, and metglasses. Examples from this work will be given in order to demonstrate the unique capabilities of SEMPA.

This work supported in part by the Office of Naval Research.
[1]K. Koike, H. Matsuyana, H. Todokoro, and K. Hayakawa, Jpn. J. Appl. Phys. **24**, 1078 (1985).
[2]J. Unguris, G. G. Hembree, R. J. Celotta, and D. T. Pierce, J. Magn. Magn. Mater. **54–57**, 1629 (1986).

Imaging domains in transmission electron microscopy (invited) (abstract)

R. K. Mishra
Physics Department, General Motors Research Laboratory, Warren, Michigan 48090-9055

Magnetic domain walls and domains inside thin electron transparent specimens of ferromagnetic materials can be imaged using the Fresnel and Focault techniques in a transmission electron microscope. Combined with the diffraction, microstructural and microchemical capabilities of modern microscopes, Lorentz microscopy offers one of the most powerful tools to study structure-property relationships in magnetic materials. In addition, using this technique, it is possible to deduce the local magnetization distribution around inhomogeneities and complex Bloch and Néel walls. Lorentz images can be used to quantitatively measure domain wall thickness and estimate domain wall energy. With modified sample holders and pole pieces, one can study *in situ* domain wall motion and the interaction of domains with microstructural features such as second phases, grain boundaries, structural defects, etc. All these will be illustrated with examples of Lorentz images from soft and hard magnets with special emphasis on the Nd-Fe-B hard magnets. Finally, the limitations of the Lorentz imaging technique utilizing the deflected electron intensities will be outlined and a new technique which utilizes the phase changes in the electron beam as it passes through the material in a scanning transmission microscope will be reviewed.

 0021-8979/87/084307-01$02.40