Advanced Hard and Soft Magnetic Materials
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Many recent advances in magnetic materials have resulted from the ability to structure the materials on an appropriate magnetic length scale. This is typically the exchange length or the domain wall width of a hard phase, but in either case the characteristic length scale is a few nanometers. As the dimensions of the grains in a magnetic nanostructure approach this limit, the magnetic properties become significantly different from those in the bulk. Some examples are the following: remanence enhancement in isotropic, single-phase hard nanostructures, exchange spring behavior of nanostructures composed of hard and soft grains where the intrinsic magnetic properties such as magnetization and anisotropy are the volume-weighted averages of the two components, vanishing anisotropy in nanostructures composed of randomly-oriented soft grains and volume-averaging of magnetostriction in nanocomposites of two soft phases. In these examples, nanostructured materials significantly extend the range of available magnetic properties. A range of materials processing issues centers on the need to control nucleation and crystal growth on a very small length scale. Another focus is on the nature of the grain boundaries and the exchange coupling across them. The problems encountered here reappear when considering planar nanostructures such as multilayers or spin-polarized tunnel junctions, where the spin diffusion length is an additional length scale that has to be taken into consideration.

The papers in this proceedings volume were presented April 5–9 at Symposia H and I at the 1999 MRS Spring Meeting in San Francisco, California. Symposium H was on "Advanced Hard Magnets—Principles, Materials, and Processing," and Symposium I was on "Amorphous and Nanocrystalline Materials for Hard and Soft Magnetic Applications." In addition, several papers on magnetic thin films from Symposium L, "Polycrystalline Metal and Magnetic Thin Films," have been included to give the reader an overview of recent developments in the field.

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