Editorial

Magnetic materials have served an important function in the development of modern society, performing as the underpinning of our sophisticated technology in electrical power, electronics, recording, telecommunications, and electromechanical industries.

Grain-oriented and non-oriented electrical sheet steels of numerous grades are used primarily in transformers and generators for the production and distribution of electrical power, a mainstay of our society. About 600,000 tons of electrical sheet steels are produced yearly in the U.S., with equal tonnages manufactured in Japan and Europe. Often considered in conjunction are motor lamination steels, which enjoy over 1 million tons in annual sales. Recent research in this class of magnetic materials has been focused on improving efficiency in applications such as transformers and motors to meet the ongoing challenge of energy conservation.

On the leading edge of magnetic materials technology are the recently-developed metallic glasses being introduced as magnetic cores, with sales of about 10,000 tons in 1991. Within 5-10 years, this radical new material is expected to capture about 50% of the distribution transformer market.

A very large and significant segment of the magnetic materials industry is devoted to permanent magnet materials production, of which there are four groups: (1) AlNiCo's, (2) hard ferrites—largely Ba and Sr, (3) rare earth cobalts, and (4) the recently-developed rare earth-irons. Especially notable is the NdFeB permanent magnet family of materials, with posted sales in the West of over $2 billion in 1990. The oldest and least expensive hard magnetic materials are the hard ferrites. They account for about 50% of sales, because they have the best price-performance ratio ($/energy product). These and other permanent magnet materials have been used in applications such as loudspeakers, relays, actuators, telecommunications equipment, electric meters, and navigation instruments.

The advent of the NdFeB magnets has been revolutionary in that exceedingly high energy (~50 MGOe) magnets are now capable of being readily produced, and they are relatively inexpensive compared to cobalt-based materials. A boom in the demand for such materials has been predicted, as these new magnet materials are expected to be used in advanced applications such as magnetic resonance tomography, automotive starter motors, and magnetic levitation trains—unsuitable applications for older permanent magnet materials. Current NdFeB research is directed toward increasing energy, improving productivity, and developing new alloys with high Curie temperatures.

Soft ferrites are often overlooked as important magnetic materials, although their component markets are in the telecommunications, TV, power supply, and computer industries, and they are commonly used in high-frequency instrument transformers and tape recording heads. Sales of soft ferrites in 1990 were over $1 billion and greater than 70,000 tons, primarily dominated by the Japanese and European markets. Sales growth is expected at 10-15% per year indicating an ever-increasing demand for soft ferrites which, curiously, face an iron oxide raw material shortage—pointing steel companies toward a profitable way to recycle some waste products.

A special group of papers is presented in this issue of the Journal of Materials Engineering and Performance. These reports were selected from presentations at the Soft and Hard Magnetic Materials Conference, part of the programming of the ASM International Materials Week program, October, 1991, in Cincinnati, Ohio. The conference was sponsored by the Magnetic Materials Group of ASM's Specialty Materials Division, and was comprised of four sessions:

Soft Magnetic Materials
Robert R. Krause, Chairperson
Inland Steel Co.

Magnetic Phenomena
David C. Jiles, Chairperson
Iowa State University

Hard Magnetic Materials 1
K.S. (Sim) Narasimhan, Chairperson
Hoeganaes Corp

Hard Magnetic Materials 2
Carol J. Painter, Chairperson
Westinghouse Electric Corp.

In addition to the chairpersons noted, assistance from international friends and fellow Magnetic Materials Group members—who helped make it possible to focus on and present this significant information on magnetic materials technology—is acknowledged: Phil Beckley, British Steel Corp.; Per Carlberg, Surahammars; Yoshi Tokunaga, Nippon Steel Corp.; and Tommi Kuzuhara, Kawasaki Steel Corp. Special thanks are extended to K.S. (Sim) Narasimhan, for his effort and guidance as the 1991 Soft and Hard Magnetic Materials Conference Chairman and Program Organizer.

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Allegheny Ludlum Corp.
Publications Chairperson
1991 Soft and Hard Magnetic Materials Conference