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Editor

Novel Functional Magnetic Materials

Fundamentals and Applications

Springer

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Preface

This book on functional magnetic materials was inspired by the rapidly growing interest in research on magnetism and magnetic materials spurred by the discovery of novel magnetic materials, including nanomaterials, and recent progress in the development of functional materials with improved magnetic and magneto-transport properties for use in a wide variety of applications. The expert chapters from leading researchers from around the world cover a wide range of experimental and theoretical work highlighting the following main topics:

- Soft magnetic materials and sensor applications
- Magnetocaloric materials and magnetic refrigeration
- Magnetic shape alloys and related applications
- Amorphous and nanocrystalline magnetic materials and applications
- Hard magnetic materials
- Magnetic semiconductors
- Composites

The aim throughout is to provide the most up-to-date information on recent developments in magnetic materials with an eye toward industry and advanced technologies.

The technology industry requires cost-effective materials with reduced dimensionality and desirable magnetic properties such as enhanced magnetic softness, giant magnetic field sensitivity, large magnetocaloric effect, and large shape memory effect for use in magnetic sensors, microelectronics, security, and energy-efficient magnetic refrigerators. In particular, the miniaturization of modern magnetoelectronic devices tends to stimulate rapid development of nanoscaled magnetic materials. This, in turn, has led to the development of novel magnetic materials in the form of ribbons, wires, microwires, and multilayered thin films, which have attracted significant attention from the scientific community.

In the area of magnetic materials, the discovery of the so-called giant magnetoimpedance effect in these materials makes them very attractive for a wide range of high-performance sensor applications ranging from use in electric

surveillance to biomedicine. In another research area, the development of novel magnetocaloric materials for advanced magnetic refrigeration technology has also generated growing interest among scientists. The majority of magnetic refrigeration needs economical, environmentally friendly materials that possess high cooling efficiencies (i.e., large magnetocaloric effect over a wide temperature range). To increase the heat exchange rate, the surface-to-volume ratio must be enhanced. Therefore progress in the development of magnetocaloric materials with low dimensionality, like ribbons, films, or wires, has drawn significant industry attention. Other magnetic materials such as hard magnets, tuneable composites, and magnetic semiconductors are also demanded by industry.

In all of these cases, a comprehensive understanding of the processing-structure-property relationship in the fabricated materials is of critical importance. Consequently, great efforts have been and continue to be focused on systematic theoretical and experimental studies with the overall goal of advancing our current knowledge of the origins of material properties in relation to some special arrangements at the nanometric scale and, relatedly, to the prediction of novel, unusual macroscopic properties based on nano- and microstructure. These efforts are a common theme throughout the chapters in this book.

I hope this publication will stimulate further interest in magnetic materials research. Last but not least, I would like to acknowledge all the contributing authors for their invaluable time, great contributions, and assistance with this book. Without such efforts we would not be able to accomplish and bring this special volume to the interested readers.

San Sebastian, Spain Arcady Zhukov

The original version of the book was revised because Arcady Zhukov's name was misspelled. An erratum explaining this can be found at DOI 10.1007/978-3-319-26106-5_11

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