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-

Y. Ishikawa N. Miura (Eds.)

Physics and Engineering Applications of Magnetism

With 223 Figures

With Contributions by

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Preface

This book was originally published in Japanese in honour of Professor S. Chikazumi on the occasion of his retirement from the University of Tokyo in March 1982. Physicists who had been supervised by him or had closely collaborated with him wrote articles on recent developments in magnetism and its engineering applications. In the preface of his excellent textbook *Physics of Magnetism* (Wiley, 1964), Professor Chikazumi says that recent research in magnetism deals with fundamental physical problems and, at the same time, with more secondary magnetic phenomena, as well as with engineering applications of magnetic materials to electromagnetic machines, permanent magnets and electronic computers, and that the purpose of his textbook is to give a general view of these magnetic phenomena, focusing its main interest at the center of such a broad field. Always keeping such a viewpoint in mind, Professor Chikazumi has contributed a great deal to both fundamental physics and applications of magnetism. This is described in Chap. 1 of this book. Many books have been published on both the physics and applications of magnetism. However, no single book has a viewpoint covering both of them. The recent development of high technology needs such a broad viewpoint for scientists and engineers since it is a product of both fundamental science and technology.

Research in magnetism is based on the response which materials show to the application of magnetic fields. Thus, a detailed study of the magnetization process is the basis of both fundamental research and applications. This book focuses on the magnetization process and related problems. Chapter 2 deals directly with this problem, and readers will learn how useful information is obtained by increasing the applied magnetic field. Neutron scattering, described in Chap. 3, is known to be a most powerful means for the microscopic investigation of magnetism. The technique is also used to measure the response of materials to the microscopic field produced by neutrons. Chapters 4 and 5 deal with the magnetization process of typical magnetic materials, compound magnetic substances and Invar alloys. These studies have given important information concerning magnetism at finite temperatures, which is one of the major problems in magnetism at present. Chapters 6–8 discuss the problems that lie between fundamental physics and applied physics. Chapter 6 deals with recent progress in magnetic anisotropy and magneto-

striction which are closely related to the magnetization process and play an important role in applications. Chapter 8 is devoted to fundamental problems of new amorphous magnetic materials, whose applications are discussed in Chaps. 9 and 10. In Chap. 7 readers will find the philosophy of an author who has long been investigating both the fundamentals and applications of magnetism with a similar viewpoint to that of Professor Chikazumi.

Chapters 9–13 deal with recent progress in the applications of magnetism. Magnetic recording, which is one of the most active research fields in Japan, is discussed in Chaps. 10–12 by leading scientists in the industrial world. Chapter 13 deals with the observation of magnetic domains governing the magnetization process, by a completely new technique developed by the author.

In editing the English edition, we have added new results since the original publication to each chapter to keep the book as up to date as possible. The editors will be very happy if this book can provide new ideas and stimulation to all those interested in magnetism, both in fundamental physics and in engineering applications. It should also play a useful role as the most recent review in this field. For the convenience of readers, the appendix explains various technical terms found in the text. We apologize for some unavoidable inconsistencies in the use of units.

We would like to thank Mr. K. Endoh and Mr. S. Makiya of the Shokabo Publishing Company who published the original book in Japanese. We are also grateful to Dr. H. Lotsch who made this publication possible. Thanks are also due to Professor K. Tajima of the Keio University who kindly translated Professor Ishikawa's original Japanese manuscript for this English edition. He also added to the chapter some topics concerning new developments in the field.

Finally, we have to mention the very sorrowful news that, during the process of editing, one of the editors, Professor Y. Ishikawa, suddenly passed away on February 28, 1986, at the age of 55. It is a great loss to the world of physics, and we would like to bless his memory and dedicate this book to him.

Tokyo, Japan
December 1990

Noboru Miura

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