ADVANCES
IN MATERIALS RESEARCH

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M. Motokawa
(Eds.)

Materials Science in Static High Magnetic Fields

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With 206 Figures

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Professor Kazuo Watanabe
Professor Mitsuhiro Motokawa
High Field Laboratory for Superconducting Materials
Institute for Materials Research, Tohoku University
2-1-1 Katahira, Aoba-ku, Sendai 980-8577, Japan
e-mail: kwata@imr.tohoku.ac.jp, motokawa@imr.tohoku.ac.jp

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Preface

There is no strict definition of the term "High Magnetic Field". It has been proposed to use this term for magnetic fields that are technically difficult to generate and therefore need special equipment or large resources. Static fields above 20 T are apparently high magnetic fields in this sense, but in the case of pulsed field 40 T is easy to obtain and any field lower than this approximate limit should not be considered as "high". When a static field is used for materials processing, even 10 T is considered as "high" because the long-term use of a conventional superconducting magnet is difficult.

Recently, there has been much technical progress in producing high magnetic fields, both pulsed and static; in large part this is due to the development of new materials. Complicated poly-helix coils are now replaced by simple Bitter coils made with plates of CuAg alloy with high strength and high conductivity; these are used in both water-cooled and hybrid magnets (now up to 45 T at NHMFL, the US National High Magnetic Field Laboratory at Tallahassee, Florida). By using CuAg wire, a nondestructive pulsed field record of 80 T has been achieved at Osaka University. For daily use in experiments, 70–75 T should soon become available. Major facilities for static high fields worldwide are planning to generate fields over 40 T by increasing the electric power.

On the other hand, the use of static high magnetic fields is expanding. Formerly these were used mainly in physics, i.e. for measuring physical phenomena, and for the characterization of materials. Application to so-called materials processing like crystal growth or heat treatment is more recent. Development of cryogen-free superconducting magnets surely contributes much to the expansion of high field applications.

The aim of this book is to survey the activities of high field applications, mainly those that are pursued at the High Field Laboratory for Superconducting Materials (HFLSM) that is attached to the Institute for Materials Research (IMR) at Tohoku University. Each chapter is composed of a general introduction to the subject and of detailed experimental results with explanations. Many books have been published concerning high magnetic fields and related subjects, but it is still considered worthwhile to publish this book as a volume of the series "Advances in Materials Research", in order to survey the current status of materials science in static high magnetic fields.

The editors are grateful to Dr. Satoshi Awaji for his help in compiling this book in its present form. They very much appreciate Prof. Yoshiyuki Kawazoe, the editor of this book series, for the original suggestion and encouragement to publish this book.

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Mitsuhiro Motokawa
Kazuo Watanabe

List of Contributors

E. Abe
Tohoku University/Research Institute of Electrical Communication
2–1–1 Katahira, Aoba–ku
Sendai 980–8577, Japan

N. Akiba
Tohoku University/Research Institute of Electrical Communication
2–1–1 Katahira, Aoba–ku
Sendai 980–8577, Japan

J. R. Anderson
University of Maryland/Dept. Physics
College Park
MD 20742-4111, USA

S. Awaji
Tohoku University/Institute for Materials Research/High Field Laboratory for Superconducting Materials
2–1–1 Katahira, Aoba–ku
Sendai 980–8577, Japan

W.P. Chen
Tohoku University/Institute for Materials Research
2–1–1 Katahira, Aoba–ku
Sendai 980–8577, Japan
and
CREST/Japan Science and Technology Corporation
Sengen, Tsukuba, 305–0047, Japan

D. Chiba
Tohoku University/Research Institute of Electrical Communication
2–1–1 Katahira, Aoba–ku
Sendai 980–8577, Japan

T. Dietl
Tohoku University/Research Institute of Electrical Communication
2–1–1 Katahira, Aoba–ku
Sendai 980–8577, Japan

S.D. Durbin
Tohoku University/Institute for Materials Research
2–1–1 Katahira, Aoba–ku
Sendai 980–8577, Japan

T. Fukase
Tohoku University/Institute for Materials Research
2–1–1 Katahira, Aoba–ku
Sendai 980–8577, Japan

W. Giriat
Centro de Fisica/IVIC
Apartado 21827
Caracas, Venezuela

T. Goto
Sophia University/Faculty of Science and Technology
7–1 Kioi–cho, Chiyoda–ku
Tokyo 102–8554, Japan

H. Hashidume
Tohoku University/Research Institute of Electrical Communication
2–1–1 Katahira, Aoba–ku
Sendai 980–8577, Japan

F. Herlach
Katholieke Universiteit Leuven/ Dept. Natuurkunde–LVSM Celestijnenlaan 200 D
B–3001 Heverlee, Belgium

T. Hirai
Tohoku University/Institute for Materials Research
2–1–1 Katahira, Aoba–ku
Sendai 980–8577, Japan

Y. Iijima
National Institute for Materials Science
1–2–1 Sengen
Tsukuba 305–0047, Japan

K. Inoue
National Institute for Materials Science
1–2–1 Sengen
Tsukuba 305–0047, Japan

G. Iwaki
Hitachi Cable Ltd.
3550 Kidamari, Tsuchiura
Ibaraki 300–0026, Japan

R. Jahana
Gakushuin University/Faculty of Science
1–5–1 Mejiro, Toshima–ku
Tokyo 171–8588, Japan

K. Katagiri
Iwate University/Faculty of Engineering
4–3–5 Ueda, Morioka 020–8551, Japan

H. Kato
Tohoku University/School of Engineering
Aramaki Aoba, Aoba–ku
Sendai 980–8579, Japan

T. Kato
Tokai University/School of Engineering
1117 Kita Kaname, Hiratsuka
259–1292, Japan

S. Kawaji
Gakushuin University/Faculty of Science
1–5–1 Mejiro, Toshima–ku
Tokyo 171–8588, Japan

G. Kido
National Research Institute for Metals
Tsukuba 593, Japan

A. Kikuchi
National Institute for Materials Science
1–2–1 Sengen
Tsukuba 305–0047, Japan

N. Kobayashi
Tohoku University/Institute for Materials Research
2–1–1 Katahira, Aoba–ku
Sendai 980–8577, Japan

H. Komatsu
Tohoku University/Institute for Materials Research
2–1–1 Katahira, Aoba–ku
Sendai 980–8577, Japan

T. Komatsubara
Tohoku University/Center for Low Temperature Science
Aramaki Aoba, Aoba–ku
Sendai 980–8578, Japan

K. Kumagai
Hokkaido University/Graduate School of Science
Nishi 8 Kita 10 Jyo, Kita–ku
Sapporo 060–0810, Japan

N. Kuroda
Kumamoto University/Dept. Mechanical Engineering and Materials Science
2–39–1 Kurokami
Kumamoto 860–8555, Japan

H. Maeda
Kitami Institute of Technology
165 Koencho Kitami
090–8507, Japan

K. Maki
Hokkaido University/Graduate School of Science
Nishi 8 Kita 10 Jyo, Kita–ku
Sapporo 060–0810, Japan

Y. H. Matsuda
University of Tokyo/Institute for Solid State Physics
Kashiwanoha, kashiwa–shi
Chiba 277–8581, Japan

F. Matsukura
Tohoku University/Research Institute of Electrical Communication
2–1–1 Katahira, Aoba–ku
Sendai 980–8577, Japan

H. Matsumoto
Tokai University/School of Engineering
1117 Kita Kaname, Hiratsuka
259–1292, Japan

S. Miyashita
Tohoku University/Institute for Materials Research
2–1–1 Katahira, Aoba–ku
Sendai 980–8577, Japan

T. Miyazaki
Tohoku University/School of Engineering
Aramaki Aoba, Aoba–ku
Sendai 980–8579, Japan

I. Mogi
Tohoku University/Institute for Materials Research
2–1–1 Katahira, Aoba–ku
Sendai 980–8577, Japan

H. Moriai
Hitachi Cable Ltd.
3550 Kidamari, Tsuchiura
Ibaraki 300–0026, Japan

M. Motokawa
Tohoku University/Institute for Materials Research/High Field Laboratory for Superconducting Materials
2–1–1 Katahira, Aoba–ku
Sendai 980–8577, Japan
email:motokawa@imr.edu

K. Murata
Osaka City University/Gradiate School of Science
3–3–138 Sugimoto, Sumiyoshi-ku
Osaka 558–8585, Japan

T. Nakada
Tohoku University/Institute for Materials Research
2–1–1 Katahira, Aoba–ku
Sendai 980–8577, Japan

N. Nakagawa
Hitachi Cable Ltd.
3550 Kidamari, Tsuchiura
Ibaraki 300–0026, Japan

K. Nakajima
Tohoku University/Institute for Materials Research
2–1–1 Katahira, Aoba–ku
Sendai 980–8577, Japan

S. Nakajima
Tohoku University/Institute for Materials Research
2–1–1 Katahira, Aoba–ku
Sendai 980–8577, Japan

T. Nishizaki
Tohoku University/Institute for Materials Research
2–1–1 Katahira, Aoba–ku
Sendai 980–8577, Japan

K. Noto
Iwate University/Faculty of Engineering
4–3–5 Ueda, Morioka 020–8551, Japan

H. Ohno
Tohoku University/Research Institute of Electrical Communication
2–1–1 Katahira, Aoba–ku
Sendai 980–8577, Japan

Y. Ohno
Tohoku University/Research Institute of Electrical Communication
2–1–1 Katahira, Aoba–ku
Sendai 980–8577, Japan

T. Okamoto
Gakushuin University/Faculty of Science
1–5–1 Mejiro, Toshima–ku
Tokyo 171–8588, Japan

T. Omiya
Tohoku University/Research Institute of Electrical Communication
2–1–1 Katahira, Aoba–ku
Sendai 980–8577, Japan

T. Sakon
Tohoku University/Institute for Materials Research
2–1–1 Katahira, Aoba–ku
Sendai 980–8577, Japan

T. Sasaki
Tohoku University/Institute for Materials Research
2–1–1 Katahira, Aoba–ku
Sendai 980–8577, Japan

G. Sazaki
Tohoku University/Institute for Materials Research
2–1–1 Katahira, Aoba–ku
Sendai 980–8577, Japan
and
Tohoku University/Center for Interdisciplinary Research
Aoba Aramaki, Aoba–ku
Sendai 980–8578, Japan

Y. Syono
Tohoku University/Institute for Materials Research
2–1–1 Katahira, Aoba–ku
Sendai 980–8577, Japan

K. Tachikawa
Tokai University/School of Engineering
1117 Kita Kaname, Hiratsuka
259–1292, Japan

K. Takamura
Tohoku University/Research Institute of Electrical Communication
2–1–1 Katahira, Aoba–ku
Sendai 980–8577, Japan

T. Takeuchi
National Institute for Materials Science
1–2–1 Sengen
Tsukuba 305–0047, Japan

N. Toyota
Tohoku University/Faculty of Science
Aoba Aramaki, Aoba–ku
Sendai 980–8578, Japan
and
Tohoku University/Interdisciplinary Research Center
Aramaki, Aoba-ku
Sendai 980–8578, Japan

S. Tsuji
Hokkaido University/Graduate School of Science
Nishi 8 Kita 10 Jyo, Kita–ku
Sapporo 060–0810, Japan

T. Ujihara
Tohoku University/Institute for Materials Research
2–1–1 Katahira, Aoba–ku
Sendai 980–8577, Japan

S. Yanagiya
Tohoku University/Institute for Materials Research
2–1–1 Katahira, Aoba–ku
Sendai 980–8577, Japan

H. Yoshino
Osaka City University/Graduate School of Science
3–3–138 Sugimoto, Sumiyoshi-ku
Osaka 558–8585, Japan

K. Watanabe
Tohoku University/Institute for Materials Research/High Field Laboratory for Superconducting Materials
2–1–1 Katahira, Aoba–ku
Sendai 980–8577, Japan
email:kwata@imr.edu

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