Guidance of Application for GIMRT

Step 1
Choose Area of Collaboration Research

RDG: Research Divisions and Groups

IRCNMS: International Research Center for Nuclear Materials Science

CRDAM: Cooperative Research and Development Center for Advanced Materials

HFLSM: High Field Laboratory for Superconducting Materials

CCMS: Center for Computational Materials Science

CN: Center of Neutron Science for Advanced Materials

Step 2
Choose Types of Collaboration

Applications handled by GIMRT office

- **Type S:** Single Research Visit
- **Type B:** Bridge proposal
- **Type O:** Overseas Research Opportunity for Young Scientist of Japan

Applications handled by ICC-IMR: International Collaboration Center

- **Type W:** International Workshop
- **Type G :** Visiting Guest Professor
- **Type F :** Research Fellowship (Extension of Single Research Visit)
- **Type J :** Integrated Joint Project, Joint Laboratory

■ For Covis (Co-Research Visit), apply Type S and Type G simultaneously

Step 3
Submit Proposal

Submit by GIMRT user system

https:// gimrt.appli.imr.tohoku.ac.jp/login

▶ **Inquiry : GIMRT office**
E-mail: gimrt-office@grp.tohoku.ac.jp

Submit to ICC-IMR office

http://www.icc-imr.imr.tohoku.ac.jp/application

▶ **Inquiry : ICC-IMR**
E-mail: icc-imr@grp.tohoku.ac.jp

Application Process

Preparation	Discussions with collaborators and local contact	
Start Proposal Submission	4 times/year February, May, August, December	
Approval	Peer review by referees including overseas researchers Decision of acceptance by proposal committee Adjustment of travel budget	6weeks - 9weeks
Provisional time planning with local contact	Exchange of documents required (e.g., acceptance letter, compliance document, VISA application, travel plan)	
Research visit		few weeks - 1 year
After visit	Submission progress report within 3-6 month after visit	
Finish	Report of research outcomes in 3 years after the visit	

IMR Institute for Materials Research, Tohoku University

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TOHOKU UNIVERSITY

GIMRT

GIMRT

Global Institute for Materials Research Tohoku

-International hub for collaborations in materials science-

SINCE 2018

As one of the world's leading institutes for materials science, IMR opens its advanced facilities, instruments, knowledge base and technologies to the worldwide materials science community.

IMR
Institute for Materials Research, Tohoku University

In collaboration with numerous overseas partners, Institute for Materials Research at Tohoku University continues giving profound positive impact on society through our shared, reaffirmed mission in the field of materials science. We pledge the light of our challenge in materials science brightens from Tohoku to the world.

GIMRT Programs

Use IMR Resources for Materials Science

- Research visit for several weeks
  - ▶Single Research Visit
- Staying at IMR for few months
  - ▶Visiting Guest Professor
- Covis(Co-research visit)
  - ▶Combination of Single Research Visit and Visiting Guest Professor

Bridge Domestic, Overseas and IMR Researchers

- Multi-core research collaboration
  - ▶Bridge proposal
- Exchange between research communities
  - ▶International Workshop
- Research at overseas institutes
  - ▶Travel Support for Young Scientist
- Long-term collaboration
  - ▶Integrated Joint Project
  - ▶Joint Laboratory

Research

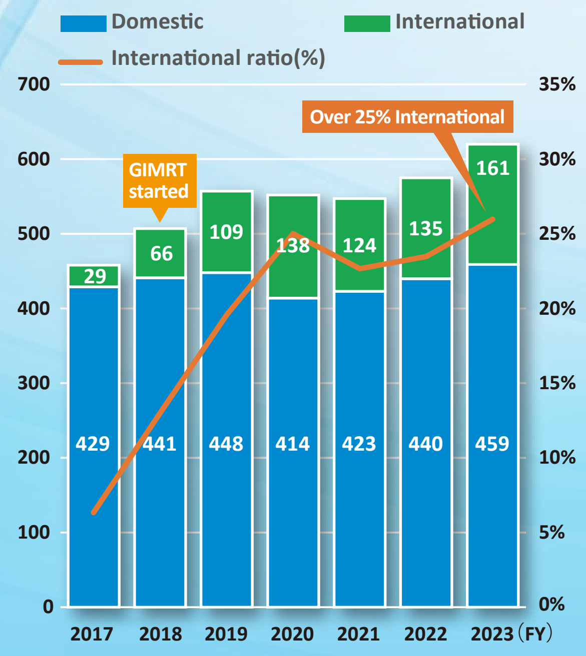
IMRT

5 reasons to join GIMRT

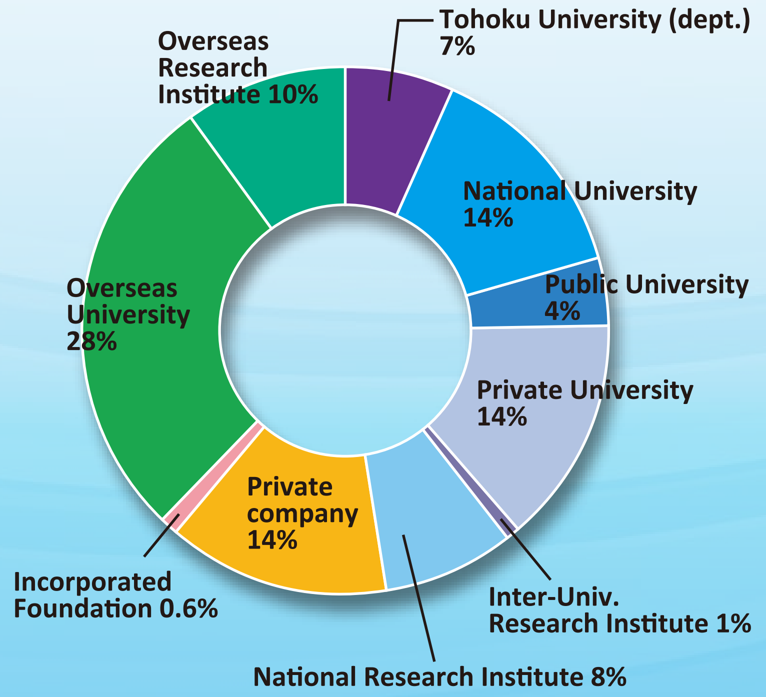
1. **Access to world-class advanced facilities** such as hot laboratory and world's highest cryogen free superconducting magnet
2. Work together with **IMR's world-leading material scientists**
3. **Strong and comprehensive support** by IMR researchers and skilled technical support staffs
4. **Join IMR's global partnerships in materials researches,** developed since its founding in 1916
5. **Enjoy Sendai, the Academic City** such as Science Park, Next Generation Synchrotron Radiation Facility "Nano Terasu"

Statistics of GIMRT activities

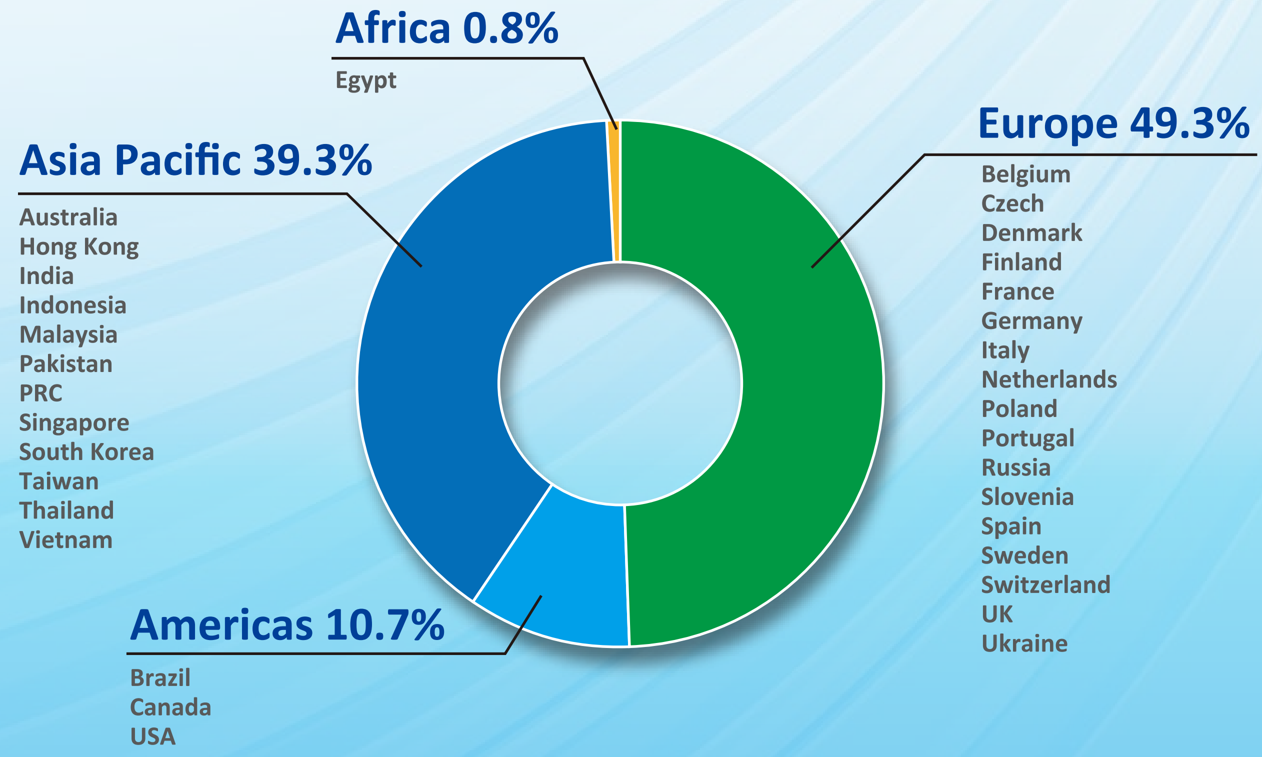
■Adopted proposals



■Visitor's affiliation (number of organization), FY2022



■International proposals by Geographic area (PI's affiliation) , FY2023



IMR´s facilities and laboratories are open for your research

RDG: Research Divisions and Groups

Outline IMR has 27 individual research divisions and groups(RDG). Collaboration with RDGs is to be conducted jointly between researchers outside IMR and RDG members. This aims to promote research utilizing novel devices, samples, research knowledge, and accumulated information possessed by each RDG.

RDG's list

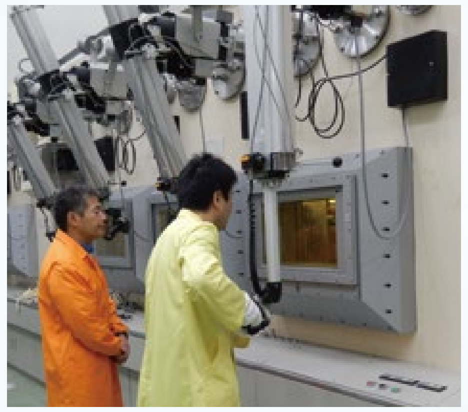
Theory of Solid State Physics/Crystal Physics/Magnetism/Surface and Interface/Low Temperature Physics/Low Temperature Condensed State Physics/Quantum Beam Materials Physics/Quantum Functional Materials Physics/Microstructure Design of Structural Metallic Materials/Materials Design by Computer Simulation/Irradiation Effects in Nuclear and Their Related Materials/Environmentally Robust Materials/Nuclear Materials Engineering/Advanced Crystal Engineering/Chemical Physics of Non-Crystalline Materials/Structure-Controlled Functional Materials/Solid-State Metal-Complex Chemistry/Non-Equilibrium Materials/Magnet Materials/Crystal Chemistry/Hydrogen Functional Materials/Multi-Functional Materials Science/Deformation Processing/Actinide Materials Science/Materials Science of Non-Stoichiometric Compounds/Analytical Science/Exploratory Research Laboratory

IRCNMS: International Research Center for Nuclear Materials Science

Outline IMR-Oarai is open for the collaborative studies on irradiated-materials and actinoid elements from all over the world. These research fields cover fundamental studies and R&D on various materials for light- water, next generation and fusion reactors as well as on novel quantum phases in f-electron systems, nuclear fuels and wastes.

Main Facilities

- Hot-Cells for Neutron Irradiated Materials
- Nanostructural Analysis Tools (TEM, 3D-AP, Positron annihilation etc.)
- Compact-Diverter Plasma Simulator with Ion-Gun TDS
- Tetra-Arc Furnace with Czochralski Puller
- Top Loading Dilution Refrigerator with He Liquefier for dHvA exp.
- Tetra-Arc Furnace for high quality single crystal growth
- Top Loading Dilution Refrigerator with helium recondensing system for dHvA experiments



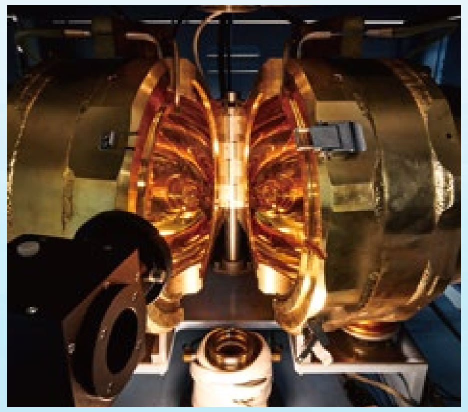
Hot-Cells for neutron irradiated materials

CRDAM: Cooperative Research and Development Center for Advanced Materials

Outline CRDAM contributes for progress of materials science, acting a hub of worldwide research collaborations and providing various research equipment for joint usage.

Equipment open for collaborative research

- Materials Synthesis Station
  - To produce various kinds of materials
- Performance Evaluation Station
  - To evaluate various states/properties of materials
- Crystal Preparation Station
  - To prepare mother alloys or single crystals



IR Image Furnace for Floating Zone Melting

HFLSM: High Field Laboratory for Superconducting Materials

Outline HFLSM is the world's leading laboratory for High-Tc based high field magnets based on cryogen free magnet technology. The magnets and instruments are open to researchers investigating superconducting, magnetic, semiconducting and other materials.

Main Magnets

- 25T Cryogen Free Superconducting Magnet
  *33T Cryogen Free Superconducting Magnet will be available in 2025
- 28T Cryogen Free Hybrid Magnet
- 31T Hybrid Magnet
- 20T Superconducting Magnet
  equipped with various instruments for Measurements and Experiments

25T Cryogen Free Superconducting Magnet

CCMS: Center for Computational Materials Science

Outline CCMS is the dedicated center for computational materials research. CCMS provides a computational resources to the materials research community and promotes the development of software for supercomputers and its application for materials science.

Main Facilities

1. Supercomputer (Large-Scale Parallel Computing Server)
   Model: Cray XC50-LC [320 nodes, 0.91 PFLOPS, 219.8 TiB memory]
2. Supercomputer (Accelerator Server)
   Model: Cray CS-Storm 500GT [29 nodes, 2.12 PFLOPS, 21.8 TiB memory]
3. Parallel Computing & Informatics Server
   Model: HPE ProLiant DL 360 [29 nodes, 0.1 PFLOPS, 16.3 TiB memory]

Supercomputer MASAMUNE-IMR

CN: Center of Neutron Science for Advanced Materials

Outline CN operates three neutron spectrometers at research reactor facility JRR-3 under a general user program, and a state-of-the-art polarization analysis chopper spectrometer at J-PARC/MLF. By utilizing the unique platform of the neutron instruments, CN aims at contributing to the development of materials science and neutron science.

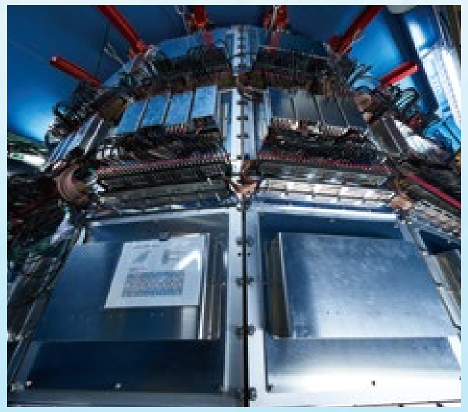
Main Facilities

JRR-3

- Triple-Axis Neutron Spectrometer (AKANE)
- Polarization Analysis Triple-axis Spectrometer (TOPAN)
- Power Diffractometer (HERMES)

J-PARC/MLF

- Polarization Analysis Chopper Spectrometer (POLANO)



Polarization Analysis Neutron Spectrometer (POLANO)

---> check the GIMRT website for more information(see last page)

Recent Research

RDG (Microstructure Design of Structural Metallic Materials Research Laboratory)

Role of cementite and retained austenite on austenite reversion from martensite and bainite in Fe-2Mn-1.5Si-0.3C alloy

The austenite (γ) reversion behaviors in Fe-Mn-Si-C alloys were comparatively investigated by changing cementite (θ) and retained austenite (RA) distributions in initial microstructures in this study. Pre-tempering or prolonged austempering coarsened the θ particles, which promoted the formation of globular austenite. RA inhibited the formation of globular austenite, and the acicular austenite was formed by its thickening. The present results demonstrate that γ reversion in the production of high strength multiphase steels can be controlled by changing the microstructure before the reversion treatment, without changing the alloying element or reversion treatment condition.

Keywords : multiphase steel, retained austenite, cementite, austenite reversion

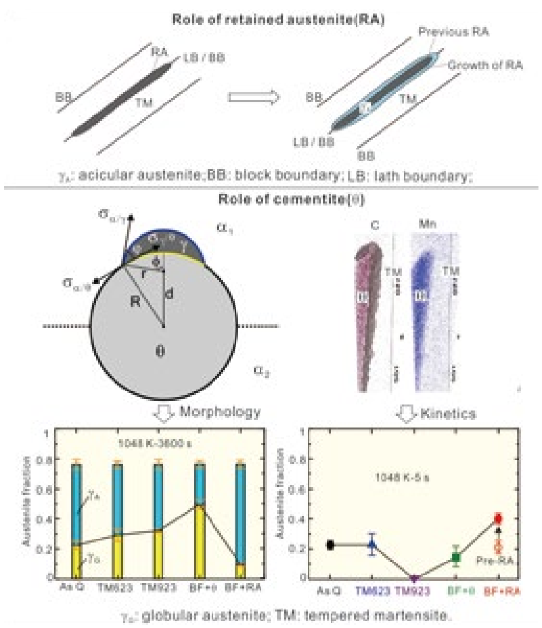


Fig. 1 Schematic illustration of the influences of cementite particles and pre-existed retained austenite on reversion behavior of globular and acicular austenite.

Publication Details
Authors :
Xianguang Zhang, Goro Miyamoto, Yuki Toji, Yongjie Zhang, Tadashi Furuhara
Goro Miyamoto (Associate Professor)
http://www.st-mat.imr.tohoku.ac.jp/en/member/index.html
Acta Materialia
DOI : 10.1016/j.actamat.2021.116772

CRDAM (Cooperative Research and Development Center for Advanced Materials)

Mechanical Strength and Electrical Conductivity of Cu–In Solid Solution Alloy Wires

Conductive spring wires for application in electrical components require high strength, high electrical conductivity, and convenient manufacturability.
We observed that Cu–In solid solution alloy wires exhibited a superior combination of strength and conductivity, which was primarily achieved by grain refinement due to their low stacking fault energy to form twin.

Keywords : electric conductivity, high strength alloys, solid solutions, alloy wire

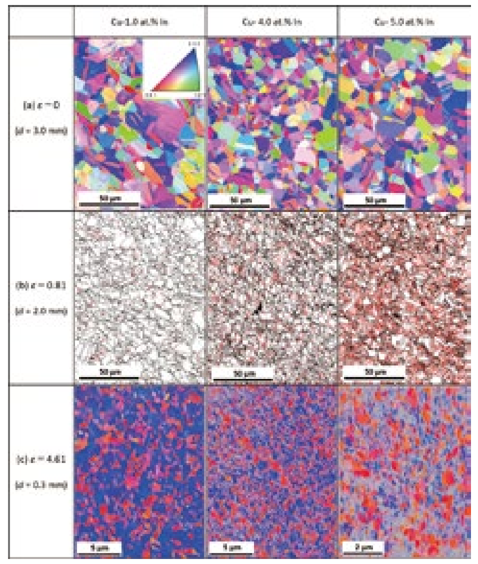


Fig. 1 Inverse pole figure and grain boundary (GB) maps obtained via electron backscatter diffraction of the cross section of the Cu–1.0, 4.0, and 5.0 at.% In alloy rods (a) before drawing, and after wire drawing to (b) 2.0 mm (ε = 0.81), and (c) 0.3 mm (ε = 4.61). In the GB map of (b), high-angle GBs with a misorientation angle in excess of 15 ° are depicted using solid-back lines, while twin boundaries corresponding to an angle of 55-62.8°are indicated by red lines.

Publication Details
Authors :
Yasunori Abe, Satoshi Semboshi, Naoya Masahashi, Sung Hwan Lim, Eun-Ae Choi, Seung Zeon Han
Naoya Masahashi (Professor and Ex. Head of CRDAM)
http://www.st-mat.imr.tohoku.ac.jp/en/member/index.html
Metallurgical and Materials Transactions A
DOI : 10.1007/s11661-022-06938-1

IRCNMS (International Research Center for Nuclear Materials Science)

High thermal conductivity in wafer-scale cubic silicon carbide crystals

An isotropic high thermal conductivity exceeding 500 W/m·K at room temperature in high-quality wafer-scale cubic SiC (3C-SiC) crystals was reported, which is the second highest among large crystals (only surpassed by diamond).
Furthermore, the thermal conductivity of 3C-SiC films was even higher than that of diamond thin films of equivalent thickness.

Keywords : silicon carbide, thermal conductivity, crystal, crystal structure

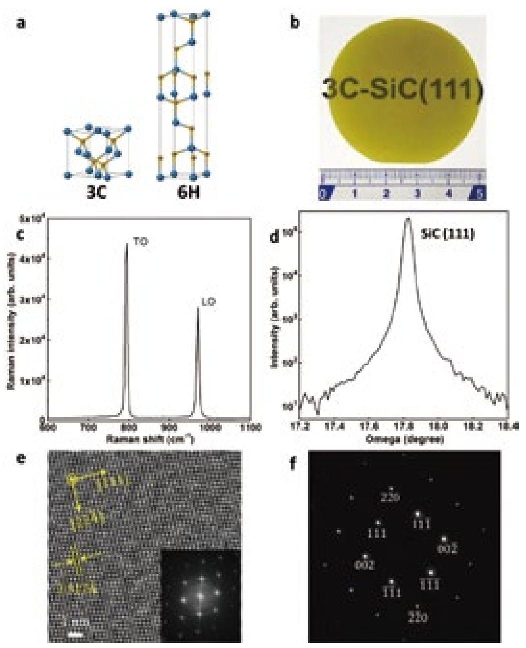


Fig. 1 a Atomic structures of 3C-SiC and 6H-SiC. b Picture of a 3C-SiC 2-inch wafer. The unit of the ruler is cm. c Raman spectrum of 3C-SiC crystal. d X-ray diffraction (XRD) of 3C-SiC. e High-resolution STEM image of 3C-SiC taken along the [1¯10] zone axis. The inset: Fast Fourier transform (FFT) of the STEM image. f Selected area electron diffraction pattern of 3C-SiC taken in the [1¯10] zone axis.

Publication Details
Authors :
Zhe Cheng, Jianbo Liang, Keisuke Kawamura, Hidetoshi Asamura, Hiroki Uratani, Samuel Graham, Yutaka Ohno, Yasuyoshi Nagai, Naoteru Shigekawa, David G. Cahill
Yasuyoshi Nagai (Professor and Head of IRCNMS)
http://www.imr-oarai.jp/en/
Nature Communications
DOI : 10.1038/s41467-022-34943-w

HFLSM (High Field Laboratory for Superconducting Materials)

Thermodynamic approach for enhancing superconducting critical current performance

The critical current density (J_c ~130 MA/cm²) and flux pinning force density (F_p ~3.17 TN/m³) for nanocomposite rare-earth metal Ba_2Cu3O_y films on metallic substrates (CCs) were successfully determined at 4.2 K using both the thermodynamic route and size, incorporating large densities of incoherent nanoparticles.
The J_c and F_p values obtained in our CC for the over-doped $REBa_2Cu_3O_y$ are the highest ever reported for superconductors.

Keywords : high temperature superconductor, REBCO, critical current density

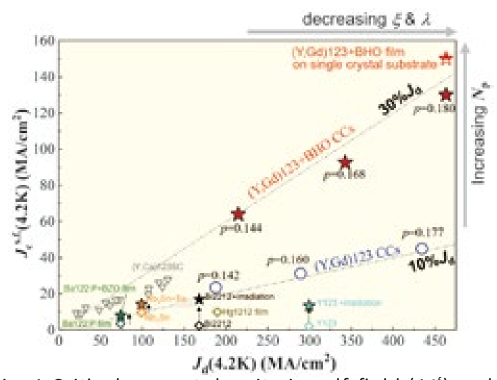


Fig. 1 Critical current density in self-field (J_c^{sf}) and depairing current density (J_d) for several HTSs at 4.2 K

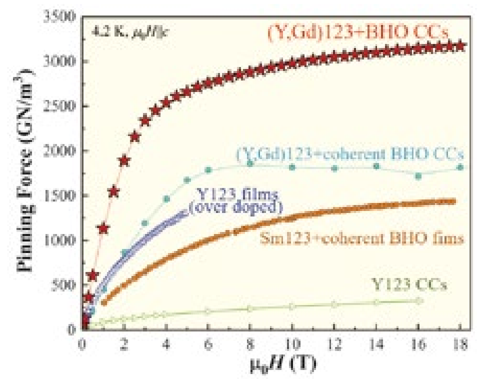


Fig. 2 Flux pinning force density F_p at 4.2 K for several HTS films for B//c

Publication Details
Authors :
Masashi Miura, Yasuyuki Kato, Takeharu Kato, Atsutaka Maeda, Naoto Sekiya, Tatsunori Okada, Satoshi Awaji, Leonardo Civale, Boris Maiorov et al.
Satoshi Awaji (Professor and Head of HFLSM)
http://www.hflsm.imr.tohoku.ac.jp/
NPG Asia Materials
DOI : 10.1038/s41427-022-00432-1

Recent Research

CCMS (High Field Laboratory for Superconducting Materials)

Local ordering and interatomic bonding in magnetostrictive $Fe_{0.85}Ga_{0.15}X$ (X = Ni, Cu, Co, and La) alloy

Although magnetostriction is expected to contribute to electric power generation in SDGs, it is still necessary to increase the magnetostriction coefficient.
We theoretically investigated the efficient doping effect in a Fe-Ga magnetostriction alloy (galfenol). Transition metal elements were unsuccessful, but La-doped galfenol showed a satisfactory increase in the magnetostriction property.

Keywords : computer modeling, magnetostriction, Fe–Ga alloy, inter-atomic bonding

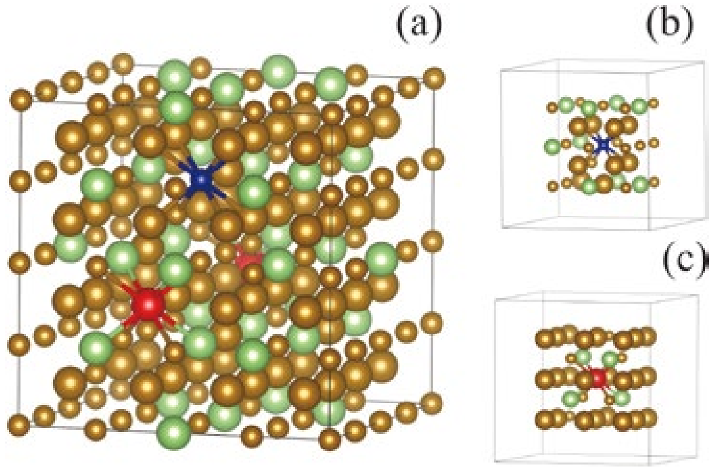


Fig. 1 (a) Atomic configuration of $Fe_{84.4}Ga_{14.8}X_{0.8}$. Here, the atom of X is Ni, Cu, Co, or La. Local atomic ordering around the dopant atoms in first and second coordination spheres for structures of (b) type A and (c) type B.

Publication Details
Authors :
Talgat Inerbaev, Aisulu Abuova, Yoshiyuki Kawazoe, Rie Y. Umetsu
Momoji Kubo (Professor and Head of CCMS)
http://www.sc.imr.tohoku.ac.jp/eng/
Computational Materials Science
DOI : 10.1016/j.commatsci.2021.110934

CN (Center of Neutron Science for Advanced Materials)

Spin excitations coupled with lattice and charge dynamics in $La_{2-x}Sr_xCuO_4$

To clarify the origin of anomalous intensity enhancement of spin excitations in $La_{2-x}Sr_xCuO_4$ (LSCO), we examined the spin excitations in a series of LSCO single crystals with x = 0, 0.075, 0.18, and 0.30, as well as in $La_{5/3}Sr_{1/3}CuO_4$.
The intensity enhancement was observed only in the superconducting samples at low temperatures, suggesting an interplay between the spin, charge, and lattice dynamics.

Keywords : neutron scattering, spin excitations, lanthanum compounds, superconducting

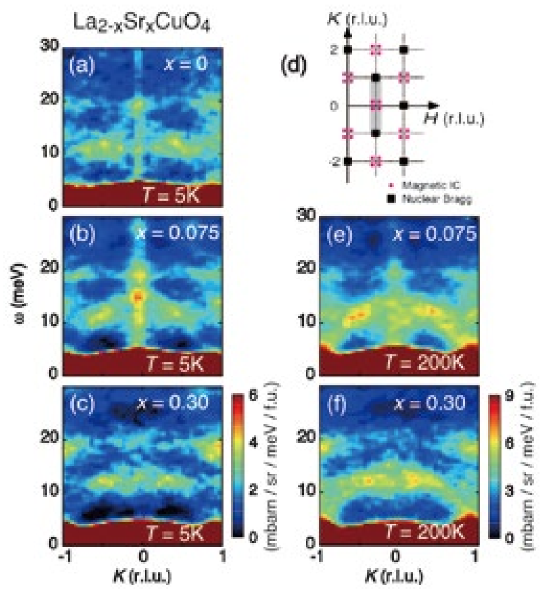


Fig. 1 Dynamical susceptibility in the ω-K plane for $La_{2-x}Sr_xCuO_4$ with (a) x = 0, (b) x = 0.075, (c) x = 0.30 at T = 5 K, (e) x = 0.075, (f) x = 0.30 at T = 200 K. The nuclear Bragg points and incommensurate magnetic positions in the H-K plane are illustrated in (d). The gray area in (d) represents the integrated area in K and range in H of the horizontal axis for intensity maps in (a)-(c), (e), and (f).

Publication Details
Authors :
Kazuhiko Ikeuchi, Shuichi Wakimoto, Masaki Fujita, Tatsuo Fukuda, Ryoichi Kajimoto, Masatoshi Arai
Masaki Fujita (Professor and Head of CN)
http://nc-imr.imr.tohoku.ac.jp/index-e.html
Physical Review B
DOI : 10.1103/PhysRevB.105.014508

Featuring program

Covis (Co-research visit)

A team visit program combined with Long & Short stay, newly started from 2022.

This program aims to form a strong and sustainable co-research team, through experiments, analysis and discussion together in a laboratory.

Example

Residential type visit (Type G= Visiting Guest Professor) ex. 2~3 months

Short-term intensive visit (Type S= Single Research Visit) ex. 2 weeks

Illustrative case

From CNRS (Centre National de la Recherche Scientifique), France

Theme : High Temperature Superconductors For Very High Field Magnets Beyond 30 T

Guest Professor
Assoc. Prof. Arnaud BADEL
Period : Apr. - Oct.2022 (visit 3 times, total 59days)

Single Visit
Dr. Julien VIALLE
Period : Jul.2022 total 9days

Effective output and continuation of the collaboration

Paper
A High Performance Insulated REBCO Pancake With Conductive Cooling Capability
IEEE Transactions on Applied Superconductivity
DOI: 10.1109/TASC.2023.3242219

Left : Assoc. Prof. BADEL
Right : Dr. VIALLE
With a Test module for High Tc Superconductor Coil

Other new cases are going on :

From Leibniz-Institut für Werkstofforientierte Technologien – IWT, Germany
Dr. Ilya Okulov (Head of Department Processing of Functional Materials)
Theme : Design of Integrated Composite Electrode Composed of Porous Metallic Current Collector and Nanoscale Active Ceramic Material

From CEA-Grenoble, France
Dr. Michael E. Zhitomirsky (Senior Researcher)
Theme : Competing Interactions and Anisotropies in Complex Triangular Antiferromagnets