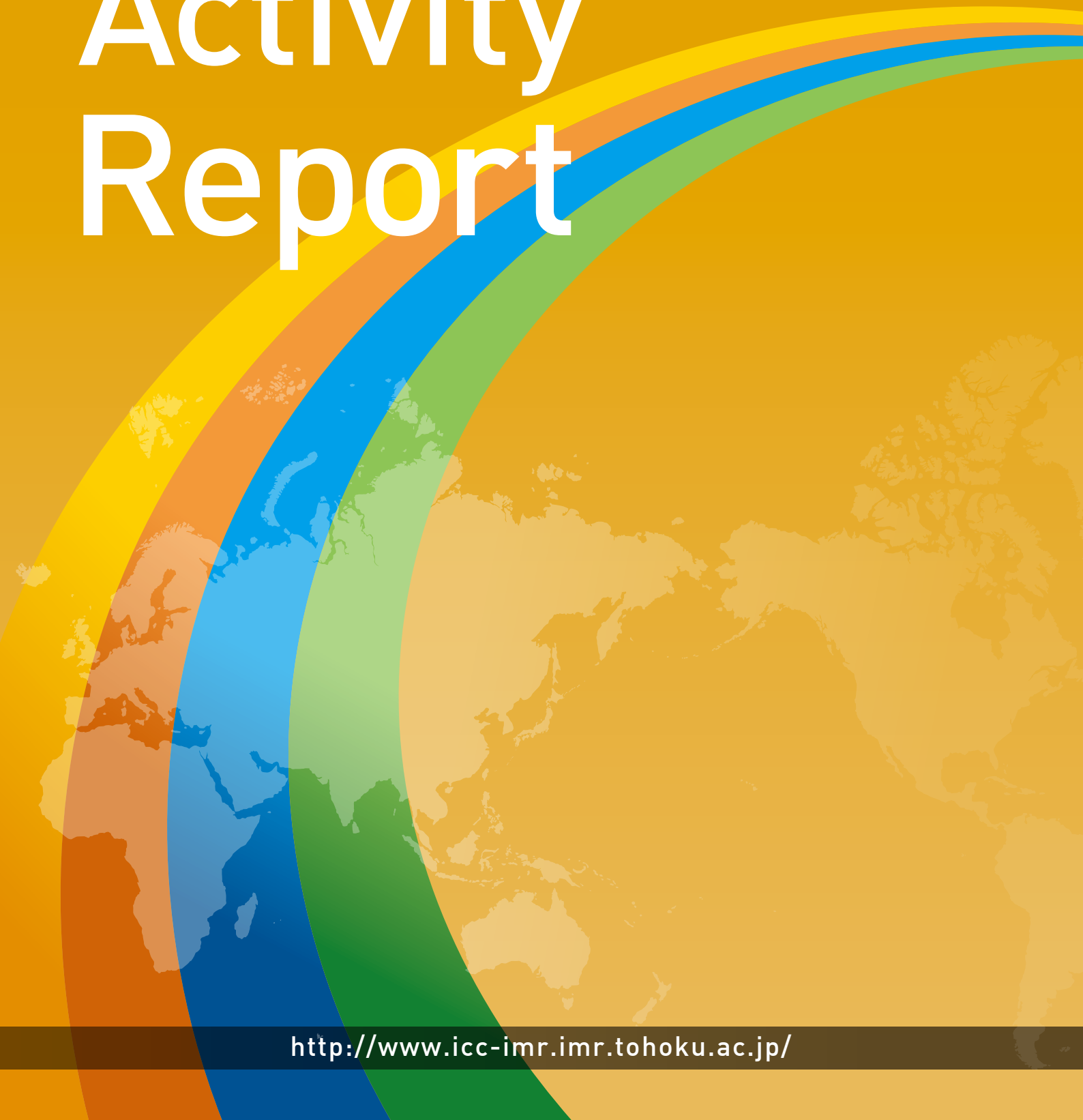
International Collaboration Center
Institute for Materials Research
Tohoku University
ICC-IMR

ICC-IMR FY2021 Activity Report



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ICC-IMR FY2021

Activity Report

International Collaboration Center

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Mission

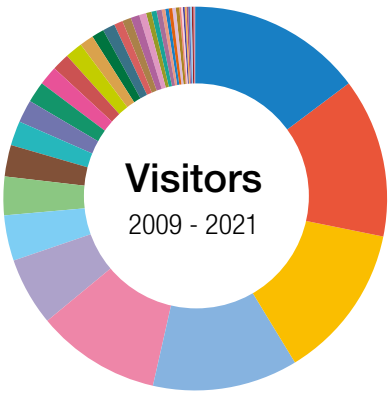
The ICC-IMR was founded in April 2008 as the center for international collaboration of the Institute for Materials Research (IMR) a center of excellence in material science, consisting of 27 research groups and five research centers. The ICC-IMR works as a gateway of diverse collaborations between overseas and IMR researchers. The ICC-IMR has invited 70 visiting professors and conducted 23 international research projects since its start-up (please inspect the graph below for more details,). The applications are open to foreign researchers and the projects are evaluated by a peer-review process involving international reviewers.

ICC-IMR coordinates five different programs:

1) International Integrated Project Research
2) Visiting Professorships
3) International Workshops
4) Fellowship for Young Researcher and PhD Student
5) Material Transfer Program

We welcome applicants from around the globe to submit proposals!

Visitors supported by ICC-Programs



USA	101	Canada	10	Brazil	2
China	91	Taiwan	10	Rumania	2
Germany	89	Singapore	8	Slovenia	2
France	83	Iran	7	Ukraine	2
Korea	71	Thailand	6	Argentina	1
UK	39	Denmark	5	Austria	1
Russia	26	Hong-Kong	5	Egypt	1
Netherlands	22	Norway	5	Indonesia	1
Switzerland	18	Mexico	4	Nepal	1
India	14	Czech Republic	3	Serbia	1
Poland	13	Italy	3	Sweden	1
Australia	12	Slovakia	3	Turkey	1
Spain	11	Belgium	2	Vietnam	1

ICC-IMR COMMITTEE MEMBERS

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Activity Report

Visiting Professors

Visiting Professors by Online

Application No.	Title in IMR	Name	Affiliation	Host Professor	Proposed Research	Term
21G01	Visiting Professor	Timothy ZIMAN	Institut Laue Langevin, France	Prof. Nojiri	Magnetic Fluctuations and the Thermoelectric Effect	2021.12.1-2022.2.28

Magnetic fluctuations and the thermoelectric effect

I summarise recent work on IrMn films, where varying the thickness of the films can lead to very large values of the Seebeck coefficient at room temperature, understood as the coupling of the conduction electrons to critical magnetic fluctuations. Comparison of the critical anomaly with different capping layers allows us to quantify the contribution of fluctuations. I also discuss work completed during my visit to the IMR on the magnetic structure and dynamics of magnetic umbrella states in rare-earth iron garnets, a class of materials becoming prominent for spintronics applications.

One purpose of my visit was to develop the subject of magnetic fluctuation induced thermoelectric effects. This was following the discovery in the group of Haiming Yu in Beijing of a giant tunable value of the Seebeck coefficient in layers of IrMn (Sa Tu et al, Nature Commun., 2020) Theoretical calculations had given predictions for the shape of the anomaly in terms of critical fluctuations close to a size dependent ordering temperature (P. Wolfle and T.Z., PRB 2021). During my visit to Sendai I had video meetings with the Beijing group and S. Maekawa at Riken to compare specific predictions of the theory with the measured temperature dependence of the Seebeck coefficients. In particular to understand the difference between samples with and without a capping layer of CoFeB (see Figure!). While the sample capped with CoFeB gives nice agreement with the theory, especially including two-dimensional fluctuations, the uncapped sample has a much weaker anomaly, because of a larger cutoff, implying a smaller Landau damping parameter. In the future, we should relate the fitted parameters to microscopic parameters of the interface, for example Rashba fields.

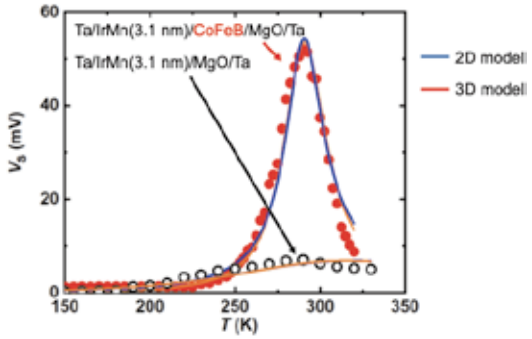

Fig.1 A fit to the critical fluctuations on the experimental thermopower in an optimised IrMn layer capped with (upper curve) and without (CoFeBN)Hancheng Wang, Haiming Yu *et al* unpublished 2022)

While in Sendai I learned of the remarkable work on thermoelectric effects by S. Okamoto in certain crystalline samples of the metallic alloy Fe_xAl_{1-x} in the group of Prof. T. Itchisubo. While it seems that the magnetic fluctuations are probably not crucial to the thermoelectricity here, the magnetic properties of these alloys are interesting in themselves and should be investigated in the future.

During my time visiting the IMR I took the opportunity to develop a theory on the family of Rare-Earth Iron Garnets, materials that have been long known, but are emerging as an important class of insulators that can be used in spintronics. In particular when the rare-earth atoms bear magnetic moments, they are known to form non-collinear magnetic "umbrella" structures. The question is to understand the origin of these structures and their influence on the dynamics, especially the chiral dynamics, crucial to spin injection in devices. We have proposed (Reference [1]), a simplified model Hamiltonian involving magnetic exchange between the highly anisotropic rare-earth and the iron moments forming a ferrimagnetic Iron lattice. The key point is that the crystal structure of the materials leads to triples of mutually orthogonal easy axes for the local strong rear earth anisotropy, and when exchange coupling is included with the relatively weakly anisotropic Fe moments, this naturally leads to a magnetic umbrella structure. In fact when both easy- and hard-axes are considered, it can lead to a "double umbrella phase). In a simplified model of the structure, solved in mean field theory, this gives a good account of the measured canting angles in TbIG as extracted from previous neutron diffraction at different temperatures (see Figure 2, upper panel) but predicts, contrary to the older measurements a continuation of

canting above the compensation temperature. This prediction, as well as small induced canting on the iron d-sites, remains to be tested in future diffraction experiments. With this simple model in hand, we could proceed to predict the effects on the dynamics [1]: the gapping of the accoustic mode, by hybridization of the crystal field levels of the rare earth and the spin deviations on the iron. Most importantly for future spin-pumping experiments we can also predict more complex behaviour of the chirality of the accoustic modes (see Figure 2, lower panel). This was stimulated by the inelastic neutron studies carried out in Grenoble and currently also in the group of Prof. M. Fujita. While in Sendai I initiated further detailed theoretical analysis with M. Mori (JAEA) with whom we wish to compare in more detail with the experiments.

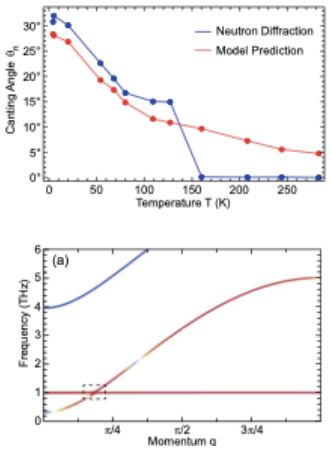

Fig.2 (Upper figure) A comparison of the calculated canting angle of the magnetic umbrella for TbIG (in red) with the values measured by neutron diffraction. A prediction of the theory is that canting should continue above the magnetic compensation point. (From Reference [1] Figure 6)

(Lower panel) Our calculated low energy excitations in a simplified lattice model with the chirality coded in colour (red and blue for the oppositely polarized modes of pure chirality) In contrast to the ferrimagnet YIG, where the rare-earth element has no magnetic moment, hybridization of the rare earth moment, with strong spin-orbit coupling leads ocal crystal field levels, leads to a gap and rather complex chirality of the original accoustic mode. (From Reference [1] Figure 4a).

References

[1] B. Tomasello, D. Mannix, S. Gepraegs, T. Ziman. Annals of Physics (in "Selected topics in condensed matter theory: in memory of Igor Dzyaloshinskii" in press, 2022)

Keywords: Thermoelectricity, Magnetic Properties, Spin Wave, Spintronic, Neutron Scattering
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Activity Report

Integrated Projects

Integrated Projects

Application No.	PI	Title	Affiliation	Proposed Research	Host	Term
2019PJT01	Jürgen Eckert	Group leader	Erich Schmid Institute, Austria	Synthesis and Investigation of Biocompatible and Biodegradable Materials.	Prof. Kato	FY2019-2021

Synthesis and Investigation of Biocompatible and Biodegradable Materials

Maintenance and improvement of human health is and always will be one of the main priorities of science. These tasks require not only new medical methods but also new materials. Therefore, two types of the materials: biocompatible crystalline (based on Ti) and biodegradable amorphous alloys were investigated in this project.

One part of the work was concerned to the biocompatible crystalline (based on Ti). In this regard was studied the novel α+β type Ti-based alloys. In this regard, the structural and mechanical properties of α+β Ti-Fe-Cu-Sn alloys are investigated. The effect of concentration of the alloying elements and other parameters like regimes of rolling and dual-axial forging operation on the microstructure and mechanical properties were thoroughly investigated. The Ti94Fe1Cu1Sn4 alloy with most promising mechanical properties was subjected to thermo mechanical treatment. But already in as-cast state it has already acceptable mechanical properties (Fig. 1, a). For example, the alloy exhibited tensile strength and tensile plasticity of about 920 MPa and 7% respectively with an elastic modulus of about 75 GPa. Such good tensile mechanical properties are explained by the optimal volume fraction balance between α and β phases texture alignment (Fig. 1, b-d). In this regard, from this alloy was obtained tubes samples, for the further biocompatible composites preparation (Fig. 1, e) and obtained powders for the 3D printing of the porous structures (Fig. 1, f). In frame of this investigation area 2 research papers, with the acknowledgement of the research project, including the paper about the investigation of high-entropy alloys were published [1, 2].

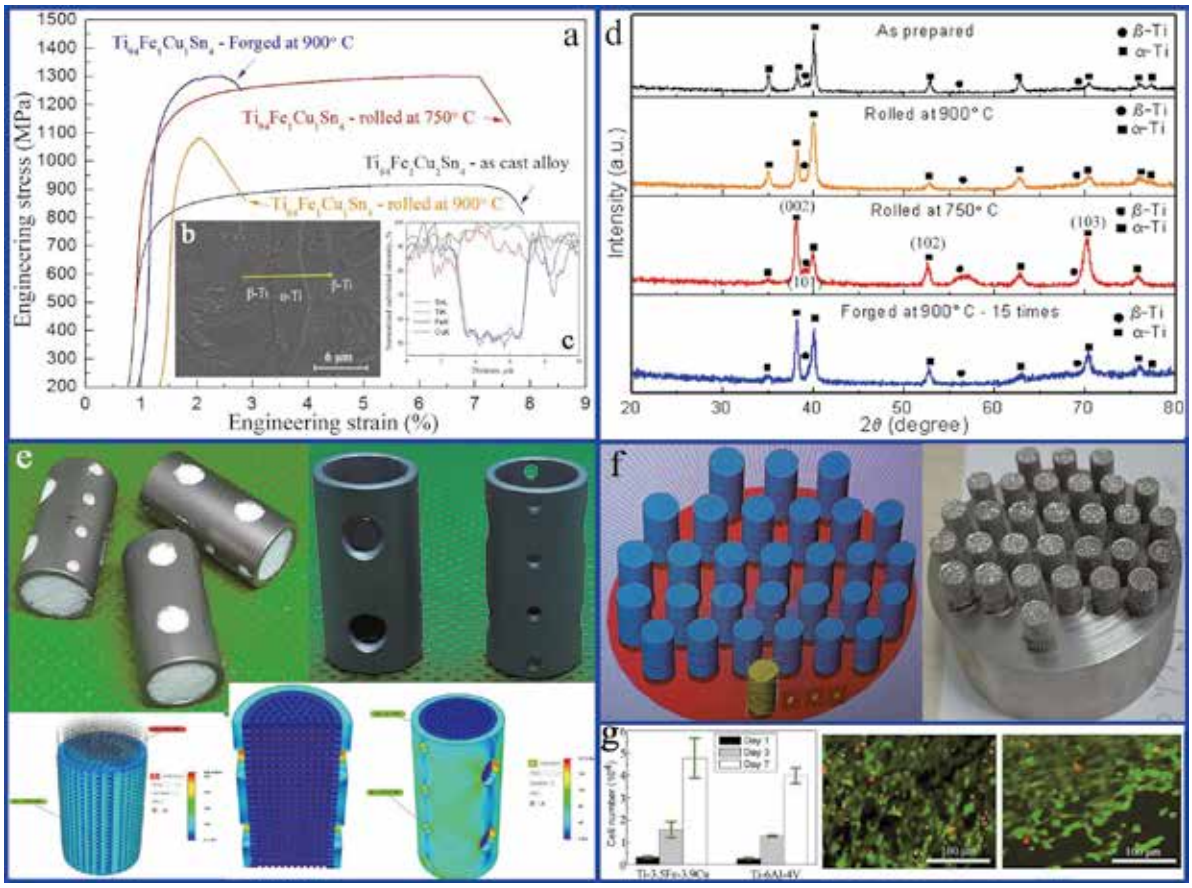

Fig.1 shows tensile mechanical properties of all the investigated samples (a), SEM (b) and EDX (c) analyses of the as-cast $Ti_{94}Fe_1Cu_1Sn_4$ alloy sample, XRD analyses of the $Ti_{94}Fe_1Cu_1Sn_4$ alloy samples in the as-cast state, rolled at 900 °C, rolled at 750 °C, forged at 900 °C for 15 times with sample rotation along the long axis (d), composite tube samples with and without biocompatible polymer (e), 3 D printed samples from the $Ti_{94}Fe_1Cu_1Sn_4$ alloy powder (f) and Cell proliferation and viability on the surface of titanium alloy (g).

1

Another part of the work was concerned to the biodegradable amorphous alloys. In this regard, the magnesium based metallic glass/PCL composite was fabricated by mechanical alloying method with subsequent co-extrusion process (Fig. 2, a). The co-extrusion process was provided in the supercooled liquid temperature region of the metallic glass and viscous region of the polymer. The metallic glass and PCL content, in the composites, was relatively stable and confirmed by XRD analyses. The composite possesses good thermal properties whereas the tensile test indicates the ability of composites to withstand deformation. In vivo studies states that the composites are biologically compatible and can be a promising biomaterial for maxillofacial surgery. In frame of this investigation area 2 research papers, with the acknowledgement of the research project, including investigation of amorphous/crystalline composites alloys were also published [3, 4].

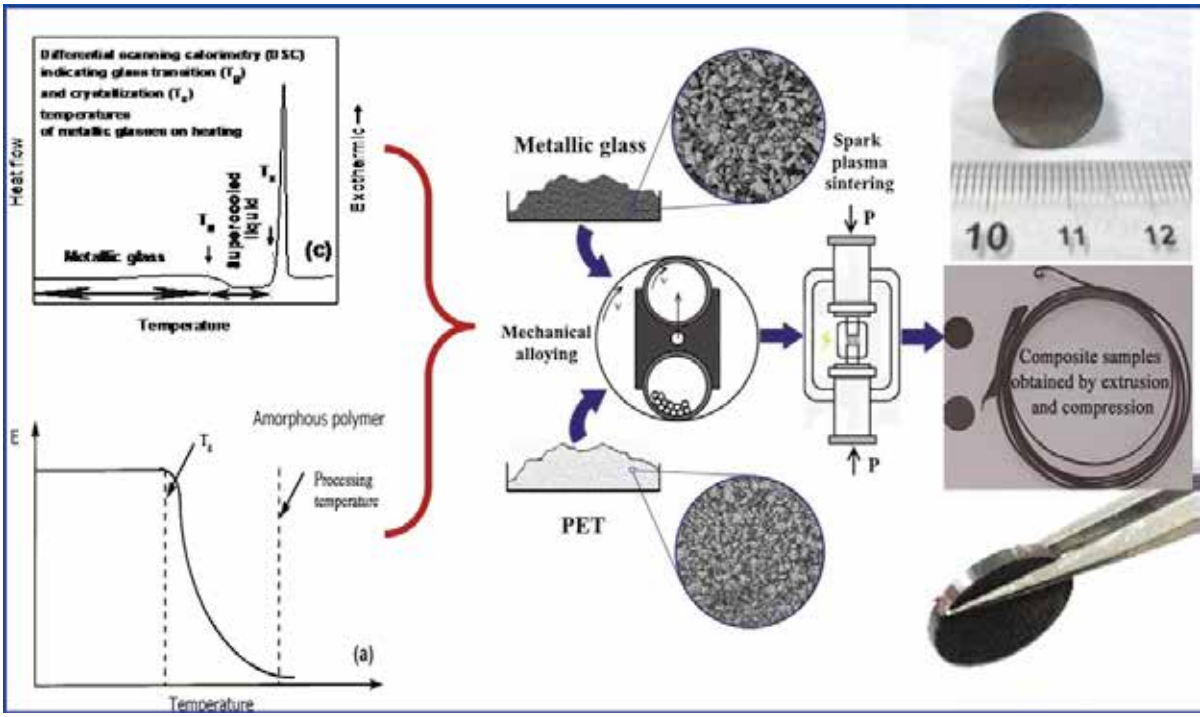

Fig.1 shows the scheme for obtaining bulk composite materials based on metallic glass and polymer during consolidation in the supercooled liquid temperature ranges.

References

[1] V. Zadorozhnyy, S. Ketov, T. Wada, S. Wurster, V. Nayak, D. Louzguine-Luzgin, J. Eckert, H. Kato, Metals 10, 34 (2020).
[2] V.Zadorozhnyy, I. Tomilin, E. Berdonosova, C. Gammer, M. Zadorozhnyy, I. Savvotin, I. Shchetinin, M. Zheleznyi, A. Novikov, A. Bazlov, M. Serov, G. Milovzorov, A. Korol, H. Kato, J. Eckert, S. Kaloshkin, S.Klyamkin, Journal of Alloys and Compounds 901, 163638 (2022).
[3] A. Sharma, A. Kopylov, M. Zadorozhnyy, A. Stepashkin, V. Kudelkina, J. Wang, S. Ketov, M. Churyukanova, D. Louzguine, B. Sarac, J. Eckert, S. Kaloshkin, V. Zadorozhnyy, H. Kato, Metals 10, 867 (2020).
[4] V. Zadorozhnyy, M. Churyukanova, A. Stepashkin, M. Zadorozhnyy, A. Sharma, D. Moskovskikh, J. Wang, E. Shabanova, S. Ketov, D. Louzguine-Luzgin, S. Kaloshkin, Metals 8, 1037 (2018).

Keywords: Composite, metallic glass, alloy.
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Activity Report

Workshops

Workshops

Application No.	Chairperson or Committee Member	Title of Workshop	Place	Term
21WS01	Prof. Awaji	27th International Conference on Magnet Technology	Hybrid, Fukuoka International Congress Center	2021.11.15-11.19
21WS02	Prof. Sasaki	The 5th Symposium for the Core Research Clusters for Materials Science and Spintronics, and the 4th Symposium on International Joint Graduate Programs in Materials Science and Spintronics	Online	2021.10.25-10.28
21WS03	Prof. Kato	16th International Workshop on Biomaterials in Interface Science	Online	2021.9.28
21WS04	Prof. Furuhara	Summit of Materials Science 2022 and GIMRT User Meeting 2022	Hybrid, Sendai International Center	2022.3.2-3

Sponsored session at 27th International Conference on Magnet Technology, Fukuoka Hybrid, 2021.11.15-19

A special session "Lesson learned" was sponsored by IMR, Tohoku University, at 27th International Conference on Magnet Technology, Fukuoka Hybrid, 2021.11.15-19. The session provided lessons based on the operation and the troubles, which are not so accessible in spite of those importance. This session focuses on those quite important lessons learned in HTS and LTS devices.

The 27th International Conference on Magnet Technology (MT27) was held at Fukuoka International Congress Center, Fukuoka, Japan and online (hybrid) from November 15 to 19, 2021. MT27 is a world largest international conference on magnet technology with the theme of "Innovation in Superconducting Magnet Technology." 5 plenary talks, 177 regular and invited orals, and 739 posters are presented. There are 822 conference attendees (195 onsite and 627 online) from 23 countries including 227 students. At the opening ceremony, the Crown Prince Akishino kindly delivered his video message expressing his recognition of the importance of the superconducting technology for the advancement of sciences and resolution of global issues that humanity faces at present such as various illness and climate change.

The special session "Lesson learned" was planned at MT27. Generally, most successes and achievements are reported in the conferences and literatures. However, the lessons based on operations and troubles are not so accessible in spite of those importance. The special session provided quite important lessons learned in low temperature and high temperature superconducting devises. The program of the special session is shown in Fig. 2. 6 special talks of "lessons learned" in Fusion, accelerator and high field magnet facilities were given. Dr. M. Bird introduced the historical operation of high field magnets beyond 27 T at National High Magnetic Field Laboratory (NHLFM) for 27 years. Some failures of superconducting outsert for the 45 T hybrid magnet and 32 T superconducting magnet were provided. In addition, Prof. S. Hahn from NHMFL and Soul National University gave recent progress on the super-conducting magnet developments with "Non insulation" technique, which can provide stable operation and good protection for HTS magnets. The attendees of the session learned many experiences, which are not provided in general conferences. In addition, GIMRT-IMR logo was shown on the MT27 web page and the program booklet as a sponsor. One page advertisement of GIMRT also appeared in the program booklet.

References

[1] https://csj.or.jp/conference/MT27/

Fig. 1 Chairpersons of the special session "Lesson Learned", Prof. P. Bruzzone (EPFL) on-line and S. Awaji (Tohoku University) on-site.

Keywords: high magnetic field, superconducting
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Special Session "Lesson Learned"

(sponsored by Institute for Materials Research, Tohoku University)

Special session "Lesson learned" is organized in the evening (JST) on Nov. 17. It is quite important to share the knowledge obtained in a history of superconducting devises such as accelerator, fusion, NMR/MRI, high field magnet and so on. Most improvements and achievements can be found in the literatures. On the other hand, lessons based on the operation and the troubles are not so accessible in spite of those importance. This session focuses on those quite important lessons learned in HTS and LTS devices. Six experts from fusion, accelerator, high field magnet communities are invited. The session organizer is Prof. Pierluigi Bruzzone, PSI, Switzerland.

Title	Speaker
Successes & Failures in Design Solutions During the 30 Year Life of ITER (and how we could have improved)	**Neil Mitchell** (ITER Organization)
Lessons Learned in the Development of Accelerator Magnets based on Nb3Sn and HTS	**Stephen Gourlay** (LBNL)
Lessons learnt in HL-LHC interaction region superconducting magnets: two case studies	**Ezio Todesco** (CERN)
Some Lessons Learned During 27 Years Operating Above 27 Tesla	**Mark Bird** (FSU)
Lessons Learned in No-insulation HTS Magnet Technology	**Seungyong Hahn** (Seoul National Universit
Bringing a Nuclear Quality Approach to Superconducting Magnets	**Liao Min** (ITER Organization)

Fig. 2 Program of the special session "Lesson Learned" at MT27 appeared on the web-site [1].

2

The 5th Symposium for the Core Research Clusters for Materials Science and Spintronics, and the 4th Symposium on International Joint Graduate Programs in Materials Science and Spintronics

研究代表者：東北大学金研　佐々木孝彦[1]
研究分担者：東北大材料科学世界トップレベル研究拠点 / AIMR　海邉健二[2]
Takahiko Sasaki[1], Kenji Kaibe[2]
[1]Institute for Materials Research, Tohoku University, Sendai 980-8577
[2]The Core Research Cluster for Materials Science / Advanced Institute for Materials Research, Tohoku University, Sendai 980-8577

Keywords: materials science, core research cluster, international joint graduate program

Tohoku University was named one of the first three Designated National Universities in Japan on June 30, 2017 by the Japanese Government. As a Designated National University, we initiated the “Core Research Clusters” to strengthen four research fields: materials science, spintronics, next-generation medical care and disaster science. Also, International Joint Graduate Program in Materials Science aims to cultivate internationally capable and highly creative professionals in the materials science field. In order to present research activities and discuss future prospects, we hold, continuing from past years, the international symposium on the Materials Science on October 25 – 28, 2021.

1. 緒言

東北大学は、2017 年 6 月 30 日、日本で最初の 3 つの指定国立大学の一つに選ばれた。指定国立大学の事業として、東北大学が強みを有する材料科学、スピントロニクス、未来型医療、災害科学の 4 つの研究分野を世界トップレベル研究拠点として整備し研究推進している。また、材料科学研究分野では国際的に活躍できる創造性豊かな人材を育成することを目的とした「材料科学国際共同大学院プログラム」(GP-MS)を実施している。この材料科学世界トップレベル研究拠点、スピントロニクス世界トップレベル研究拠点および大学院プログラムの活動と研究成果を発表し、今後の展望を議論するために、2021 年 10 月 25－28 日に第 5 回目となる国際シンポジウムをオンラインにて開催した。なお、今回は本学の世界トップレベル研究拠点の目標の 1 つである学内の卓越したリソースの結集の一環として、各拠点やセンター、プログラム等の構成部局に加えて、金属材料研究所国際共同利用・共同研究拠点(GIMRT)や AIMR フラウンフォーファープロジェクトセンターも共催として合同で開催をした。

2. 開催内容

第 5 回目となる本国際シンポジウムでは、“Materials science and Spintronics leading the green digital innovation” と題して、SDGs や環境エネルギーに配慮しながら新たな価値を創成していくことを目指したプログラム編成が行われた。あわせて第 5 回目となるスピントロニクス世界トップレベ

ル研究拠点によるセッションや、第 4 回目となる材料科学国際共同大学院に参画する大学院生によるセッションの企画運営、AIMR フラウンフォーファープロジェクトセンターによる研究成果とこれまでの振り返り等に関する議論等が行われた。今回も昨年度に引き続き新型コロナ感染症拡大防止のためにオンライン開催となったが、ポストコロナやウイズコロナを見据えて、これまでのシンポジウム以上の発表数や参加者を得ることができた。4 日間の会期中に国内外から参加の 4 件(うち海外から 3 件)のプレナリー講演のほか、国内外および学内からの招待講演により材料科学世界トップレベル研究拠点では 3 セッション 9 名、スピントロニクス世界トップレベル研究拠点では 5 セッション 24 名、GP-MS では 4 セッション 15 名、AIMR フラウンフォーファープロジェクトセンターでは 1 セッション 3 名の合計 13 セッション 52 名の口頭発表が行われた。また、ポスターセッションでは、AIMR・甲斐洋行助教が開発したオンラインポスターセッションツール(https://www.tohoku.ac.jp/japanese/2020/08/press20200821-04-withpost.html)を活用して 116 件の発表が行われた。オンライン開催においてもできるだけ参加者間のコミュニケーションがその場ではかれるようにバーチャルリアリティ会場を設定し、講演者や参加者が会場をアバターにてロールプレイングゲーム風に動き回り、コミュニケーションはチャットとオンライン通話を併用してできる機能を付加して新たな実施形式を試みた。

・参加者：合計 437 名（日本：415 名、海外：22 名）

【セッション概要】

(1)Plenary セッション

・Plenary 講演：4 セッション－学外 4 名(海外 3 名)

(2)Invited セッション

・材料科学世界トップレベル研究拠点：3 セッション 9 名－学内名 6、学外 3 名(海外 2 名)

・スピントロニクス世界トップレベル研究拠点：5 セッション 24 名－学内 11 名、学外 13 名(海外 5 名)

・GP-MS：4 セッション 15 名－学内 4 名、学外 11 名(うち海外 10 名)

・AIMR フラウンフォーファープロジェクトセンター：1 セッション 3 名－学内 2 名、学外 1 名(海外 1 名)

(3)Poster セッション

・116 件

● 1 日目（2021 年 10 月 25 日）

大野英男東北大学総長の開会挨拶に引き続き、小谷元子理事・材料科学世界トップレベル研究拠点長を座長として University of Melbourne の Prof. George V. Franks により“3D printing of hierarchical porous ceramics using aqueous suspension-oil formulations”と題する講演が行われた。これに続きスピントロニクス世界トップレベル研究拠点の平山祥郎拠点長を座長として、理化学研究所の Prof. Seigo Tarucha により“Si Platform for Implementing Fault Tolerant Spin-based Quantum Computing”と題する講演及び Prof. Gerrit E. W. Bauer を座長として、University of Groningen の Prof. Bart J. van Wees により“Electrical and thermal generation of spin currents by magnetic graphene”と題する講演が行われた。この後、スピントロニクス世界トップレベル研究拠点の GP-Spin セッション、ポスターセッションをはさみ、成島尚之教授を座長として、University of Cambridge の Prof. Serena M. Best により“Design of Tissue Engineering Scaffolds - Still Learning our ABC?”と題して講演が行われた。なお、日本とオーストラリア、ヨーロッパの間の時差の関係で、朝と夕方に分けたオンラインプレナリー講演を行うことになった。

● 2 日目（2021 年 10 月 26 日）

午前には、ポスターセッションが開催された。午後には材料科学世界トップレベル研究拠点の”Evaluation and sensing”、”Processing”、”Mathematical Science and Computation”の各セッション、スピントロニクス世界トップレベル研究拠点の”Spintronics Materials”、GP-MS の学生セッション 2 件が開催された。

ポスター発表に関し、オンラインシンポジウムなどでは PDF ポスターの閲覧や ZOOM のブレイクアウトルームの利用など種々の開催形式が試みられている。しかし、従来のポスターを見ながら発表者・参加者間でインタラクティブにディスカッションを行うことを実現することは難しい。できるだけ従来のポスター発表形式に近づける試みとして、AIMR・甲斐洋行助教が開発したオンラインポスターセッションツールを活用した発表が行われた。オンライン開催においてもできるだけ参加者間のコミュニケーションをその場ではかれるようにバーチャ

ルリアリティ会場を設定し、講演者や参加者が会場をアバターにてロールプレイングゲーム風に動き回り、コミュニケーションはチャットとオンライン通話を併用してできる機能を付加して新たな実施形式を試みた。発表者、参加者ともにアバター操作しつつ、コミュニケーション機能の進展によって、よりリアルに近い臨場感を体感できるものとなった。

・ポスター発表数 : 116 件ー材料科学世界トップレベル研究拠点 52 件、スピントロニクス世界トップレベル研究拠点 54 件、GP-MS 10 件

・ポスター発表表彰 : Best Poster Award 9 件、Poster Award 14 件

● 3 日目（2021 年 10 月 27 日）

3 日目はスピントロニクス世界トップレベル研究拠点の” Spintronics Memory and Its Application”、” Spin-Mechatronics”、” Topology”の各セッション、AIMR フラウンフォーファープロジェクトセンターの 1 セッション、GP-MS の学生セッション 1 件が行われ、午前 9 時から午後 7 時に渡り発表と活発な質疑応答が行われた。

● 4 日目（2021 年 10 月 28 日）

最終日は、スピントロニクス世界トップレベル研究拠点の”Outlook for Non-Linear Quantum Magnonics”セッションと GP-MS の学生セッション 1 件が行われた。その後、合同でポスターアワードセレモニーと平山スピントロニクス世界トップレベル研究拠点長による closing remarks により終了した。

3. まとめ

第 5 回となる本シンポジウムは、前回に続きオンラインでの開催となったが、本学の材料科学分野に関係する多くの部局・拠点・プログラム等の参画により本学の有する卓越したリソースが結集して創出された研究成果を日本の国内外に広くアピールする場となった。また運営・企画の工夫により、実開催と同等以上の成果をあげることができた。次回以降の開催形式は、現在のところ未定であるが、会場発表とオンラインを併用したハイブリット形式が標準化すると思われる。またポスター発表についてもよりリアルな臨場感に近づくように日進月歩の技術・アプリケーションを取り入れながら改善を図っていく必要がある。

謝辞（Acknowledgement）

本シンポジウムは、材料科学世界トップレベル研究拠点、スピントロニクス世界トップレベル研究拠点、材料科学国際共同大学院プログラム(GP-MS)、AIMR フラウンフォーファープロジェクトセンターが主催し、東北大学高等研究機構 International Affairs Center(IAC)の協力のもと GIMRT の共催により実施されたものです。運営・企画に参画されたすべての方に謝意を表します。

参考

1) 本シンポジウムホームページ
https://confit.atlas.jp/guide/event/crcgpms2021/top
2) シンポジウムプログラム

The 5th Symposium for the Core Research Clusters for Materials Science and Spintronics, and The 4th Symposium on International Joint Graduated Program in Materials Science

October 25 (Mon) – 28 (Thu), 2021, Online

Time table (JST)

October 25 (Monday)

Materials Science	Spintronics	GP-MS
10:00-10:10 Opening address Hideo Ohno		
10:10-10:55 Plenary 1 **PL1 George V. Franks** Chair: Motoko Kotani		
10:55-11:40 Plenary 2 **PL2 Seigo Tarucha** Chair: Yoshiro Hirayama		
11:40-12:35 Lunch		
12:35-13:20 Plenary 3 **PL3 Bart J. van Wees** Chair: Gerrit E. W. Bauer		
	13:20-14:50 S1 GP-Spin S1-1 Takashi Kobayashi S1-2 Mai Kameda S1-3 Yuta Yahagi S1-4 Takashi Saitoh S1-5 Shogo Yamashita Chair: Justin Llandro	
14:50-17:00 Poster Session 1		
17:00-17:25 Break		
17:25-18:10 Plenary 4 **PL4 Serena M. Best** Chair: Takayuki Narushima		

October 26 (Tuesday)

Materials Science	Spintronics	GP-MS
10:30-12:00 Poster Session 2		
12:00-13:30 Lunch		
13:30-15:00 M1 Evaluation and Sensing M1-1 Atsushi Momose M1-2 Hiroshi Jinnai M1-3 Kazu Suenaga Chair: Masami Terauchi		
15:00-15:20 Break		
15:20-16:50 M2 Processing M2-1 Cyril Aymonier M2-2 Yasuhiro Fukushima M2-3 Maiko Nishibori Chair: Tadafumi Adschiri		
16:50-17:10 Break		
17:10-18:40 M3 Mathematical Science and Computation M3-1 Makoto Ohta M3-2 Momoji Kubo M3-3 Simona Perotto Chair: Hiroshi Suito	17:00-19:00 S2 Spintronics Materials S2-1 Rie Y. Umetsu S2-2 Yuya Sakuraba S2-3 Stefan Blügel S2-4 Hidekazu Kurebayashi Chair: Koki Takanashi / Masafumi Shirai	17:00-19:00 G1 Student Session 1 G1-1 Kirrily C. Rule G1-2 Max Avdeev G1-3 Shinichiro Yano G1-4 Fang Xiaoqi Chair: Pang Xiaoqi
		19:00-19:30 Break
		19:30-21:30 G2 Student Session 2 G2-1 Jun Takeya G2-2 Lionel Hirsch G2-3 Yang Wang G2-4 Takaya Matsuo Chair: Takaya Matsuo

October 27 (Wednesday)

Materials Science	Spintronics	GP-MS
	9:00-11:00 S3 Spintronics Memory and Its Application S3-1 Jon M. Slaughter S3-2 Shoji Ikeda S3-3 Hiroki Koike S3-4 Ada S. Y. Poon Chair: Tetsuo Endo	
11:00-13:00 Lunch		
	13:00-15:00 S4 Spin-Mechatronics S4-1 Hiroyuki Chudo S4-2 Jorge Puebla S4-3 Yukio Nozaki S4-4 Daichi Chiba Chair: Hiroaki Matsueda	
15:20-16:50 M4 Fraunhofer Project M4-1 Gildas Alan Diguet M4-2 Mario Baum M4-3 Masayoshi Esashi Chair: Shin-ichi Orimo		
	17:00-19:00 S5 Topology S5-1 Yayu Wang S5-2 Atsushi Tsukazaki S5-3 Koji Muraki S5-4 Takafumi Sato Chair: Seigo Souma	17:00-19:00 G3 Student Session 3 G3-1 Achim Walter Hassel G3-2 Takao Hanawa G3-3 Haruka Saito Chair: Haruka Saito

October 28 (Thursday)

Materials Science	Spintronics	GP-MS
	9:00-11:00 S6 Outlook for Non-Linear Quantum Magnonics S6-1 Dmytro A. Bozhko S6-2 Koi Yamamoto S6-3 Tomosato Hioki S6-4 Mehrdad Elyasi Chair: Eiji Saitoh	9:00-11:00 G4 Student Session 4 G4-1 Eriks Rozners G4-2 Gang Chen G4-3 Katherine Kedzierska G4-4 Okeke Chioma Uche Chair: Okeke Chioma Uche
	Poster award ceremony Closing remarks Yoshiro Hirayama	

The 5th Symposium for the Core Research Clusters for Materials Science and Spintronics, and the 4th Symposium on International Joint Graduate Programs in Materials Science and Spintronics プログラム

16th International Workshop on Biomaterials in Interface Science

研究代表者：東北大金研 加藤秀実
研究分担者：東北大歯 佐々木 啓一 高橋 信博 鈴木 治　東北大歯医工 西條 芳文

Hidemi KATO[1], Keiichi SASAKI[2], Nobuhiro TAKAHASHI[2], Osamu SUZUKI[2], Yoshifumi SAIJO[3]

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Keywords: international workshop, biomaterials, interface science, bioengineering, oral health

The international joint symposium 2021 was held online on September 28, 2021, which was co-sponsored by the Institute for Materials Research (IMR), Graduate School of Dentistry, Graduate School of Biomedical Engineering and Medical Science at Tohoku University. The symposium contains four sessions, including the Oral Health Care, Bioengineering, Young investigators, and Biomaterials. During the symposium, 20 oral presentations including 4 invited lectures and other 16 oral talks were given by the researchers from Australia, Singapore, Indonesia, Finland, and Japan. Interdisciplinary discussions and state-of-the-art research presentations on various types of materials were progressed by international researchers and students from wide research fields such as material science, dentistry, and medical engineering, which contributes significantly to the progress of research among both domestic and overseas researchers.

1. 概要

東北大学金属材料研究所、歯学研究科、医工学研究科と 3 つの組織で生体材料研究を中心とした研究発表の場として毎年開催しているワークショップである。開催形式はオンラインで開催され、オーストラリア、シンガポール、インドネシア、フィンランドからも参加があった。研究内容としては研究テーマごとに 4 セッションに分けて行われ、招待講演、口頭発表からなる共同ワークショップとなった。

2. 内容

生体材料研究を中心として 2021 年 9 月 28 日、The 16th International Workshop on Biomaterials in Interface Science としてオンラインで開催された。組織メンバーは、東北大学（金属材料研究所、大学院歯学研究科、大学院医工学研究科）であった。セッションテーマとしては、① Oral Health Care、② Bioengineering、③ Young innovators、④ Biomaterials の 4 テーマとなり、招待講演者 4 名、口頭発表 16 名であった。海外講演者の招待講演とし

ては Qing LI 先生より、「A bone remodeling procedure for application in mandibular reconstruction」というタイトルで、 Bee Tin GOH 先生より、「Regeneration of the dentoalveolus- innovations for clinical translation」というタイトルで、Ruslizam DAUD 先生より、「Biomechanical overloading on dental implant」というタイトルで、Miho NAKAMURA 先生より、「A new concept of hydroxyapatite for bone regeneration –nano structure and response to mechanical stratin」というタイトルでそれぞれ講演が行われた。オンラインでの開催ではあったが、国内外からの参加者は約 75 名となり有意義な会であった。

Summit of Materials Science 2022 and GIMRT User Meeting 2022 in Person Meeting (March 2 – 3, 2022)

The joint international conference SMS 2022 and GIMRT User Meeting 2022, which has been suspended since 2020, were held as in person meeting at the Sendai International Center for the first time in two years. At the conference, 29 invited lectures (including 8 young invited speakers of jointly held KINKEN WAKATE 2022) in 5 fields of "Quantum Beam", "Functional Material", "Nuclear Materials / 5f", "Computational Materials Science / Informatics", "High Magnetic Field and Magnetism", and "Structural Materials" were presented by researchers from 6 nations. The participants enjoyed the rare on-site international conference under the pandemic situation. It became a memorable event as a precursor to the revival of international joint research together with the significant relaxation of border measures of Japan from March. Following this success, GIMRT plans to hold several international conferences from coming summer to autumn and welcomes visitors from abroad.

DATE March 2–3, 2022

VENUE Sendai International Center

SMS2022 & GIMRT User Meeting 2022

Summit of Materials Science and Global Institute for Materials Research Tohoku User Meeting

PROGRAM

Day1 March 2 10:00-19:40

Day2 March 3 8:30-19:00

KEYNOTE SPEAKERS

R. Chatterjee IIT Delhi	V. Khovaylo NUST MISIS	G. Knebel CEA-Grenoble	D. Louca Univ. Virginia	H-S. Shin Andong Nat. Univ.	S. Sinnott Penn State Univ.	C. C. Tasan MIT
N. Hashimoto Hokkaido Univ.	K. Ishii QST	H. Kageyama Kyoto Univ.	Y. Kawamura Kumamoto Univ.	Y. Kumagai Tokyo Inst. Tech.	R. Matsuda Nagoya Univ.	

Contact

2-1-1 Katahira, Aoba-ku, Sendai 980-8577, Japan
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Institute for Materials Research, Tohoku University

Research IMRT

Summit of Materials Science 2022 & GIMRT User Meeting 2022 Time Table

March 2nd.		March 1st.	Session and Speakers
JST	EU-CET	USA-CST	***Opening (Chair: T. Sasaki)***
10:00	2:00	19:00	Opening Address T. Furuhara
			Greeting T. Ziman
			Activity of GIMRT T. Sasaki
			Quantum Beam (Chair: M. Fujita)
10:30	2:30	19:30	A1: D. Louca, Keynote
11:10	3:10	20:10	A2: K. Ishii, Keynote
11:50	3:50	20:50	A3: Y. Ishii, Invited
12:10	4:10	21:10	A4: H. Kumigashira, Invited
12:40	4:40	21:40	A5: K. Ohishi, Invited
13:10	5:10	22:10	Lunch Break
			Functional Material (Chair: H. Miyasaka)
14:00	6:00	23:00	B1: R. Chatterjee, Keynote
14:40	6:40	23:40	B2: H. Kageyama, Keynote
15:20	7:20	0:20	B3: R. Matsuda, Keynote
16:00	8:00	1:00	B4: Y. Nii, Invited
16:30	8:30	1:30	B5: H. Sakai, Invited
17:00	9:00	2:00	Break
			Nuclear Materials/ 5f (Chair: D. Aoki)
17:20	9:20	2:20	C1: N. Hashimoto, Keynote
18:00	10:00	3:00	C2: G. Knebel, Keynote
18:40	10:40	3:40	C3: M. Nakase, Invited
19:00	11:00	4:00	C4: Y. Du, Invited
19:20	11:20	4:20	C5: M. Yajima, Invited
19:50	11:50	4:50	Closing

March 3rd.		March 2nd.	Session and Speakers
			Computational Materials Science/Informatics (Chair: M. Kubo)
8:30	0:30	17:30	D1: S. B. Sinnott, Keynote
9:10	1:10	18:10	D2: Y. Kumagai, Keynote
9:50	1:50	18:50	D3: Q. Chen, Invited
10:10	2:10	19:10	D4: A. Ishii, Invited
10:30	2:30	19:30	D5: K. Shimizu, Invited
			Structural Material I (Chair: K. Fujiwara)
10:50	2:50	19:50	G1: C. C. Tasan, Keynote
11:30	3:30	20:30	***E: Poster Session***
12:50	4:50	21:50	Lunch Break
			High Magnetic Field and Magnetism (Chair: S. Awaji)
13:40	5:40	22:40	F1: H-S. Shin, Keynote
14:20	6:20	23:20	F2: V. Khovaylo, Keynote
15:00	7:00	0:00	F3: R. Umetsu, Invited
15:30	7:30	0:30	F4: Y. Mitsui, Invited
15:50	7:50	0:50	F5: V. Petrykin, Invited
16:20	8:20	1:20	Break
			Structural Material II (Chair: K. Fujiwara)
16:40	8:40	1:40	G2: Y. Kawamura, Keynote
17:20	9:20	2:20	G3: N. L. Okamoto, Invited
17:40	9:40	2:40	G4: S. Hiromoto, Invited
18:10	10:10	3:10	Closing
18:30	10:30	3:30	End

Program

March 2

10:00-10:30 Opening — **Chair: T. Sasaki**

Opening Adress	T. Furuhara, IMR, Tohoku University
Greeting	T. Ziman, Institut Laue Langevin
Activity of GIMRT	T. Sasaki, IMR, Tohoku University

10:30-13:10 Quantum Beam — **Chair: M. Fujita**

A1 Exotic Magnetoresistive Materials
D. Louca, University of Virginia 7

A2 Resonant Inelastic X-Ray Scattering Studies on Transition-Metal Oxides
K. Ishii, National Institutes for Quantum Science and Technology 8

A3 Time-Resolved XMCD Measurements for Spin Oscillation Under FMR
Y. Ishii, Faculty of Science, Tohoku University 9

A4 Development of Resonant-Tunneling Mott Transistor Using Synchrotron-Radiation Spectroscopy
H. Kumigashira, IMRAM, Tohoku University 10

A5 Polarization Analysis of Small-Angle Neutron Scattering at TAIKAN and Its Application to Material Science
K. Ohishi, CROSS 11

14:00-17:00 Functional Material — **Chair: H. Miyasaka**

B1 Enhanced Superconductivity in the Topologically Non-Trivial Half-Doped $Y_{(1-x)}Er_xPdBi$ Thin-Films
R. Chatterjee, Indian Institute of Technology, Delhi (IIT D) 12

B2 Mixed-Anion Compounds
H. Kageyama, Kyoto University 13

B3 Molecular Trapping and Photoreactions in the Nanospace of Porous Metal Complexes
R. Matsuda, Nagoya University 14

B4 Nonreciprocal Transport and Its Inverse Effect in Noncentrosymmetric Magnets
Y. Nii, IMR, Tohoku University 15

B5 Block-Layer Design for High-Mobility Magnetic and Polar Dirac Materials
H. Sakai, Osaka University 16

17:20-19:50 Nuclear Materials/ 5f **Chair: D. Aoki**

C1 Recent Activities of HEA Research for Nuclear Application
N. Hashimoto, Hokkaido University 17

C2 Unconventional Superconductivity in the Heavy Fermion Paramagnet UTe_2
G. Knebel, CEA-Grenoble 18

C3 Exploring the Thermodynamic Properties of Actinium in Solution State by Utilization of Solvent Extraction Technique
M. Nakase, Tokyo Institute of Technology 19

C4 Microstructure Characterization of 12Cr ODS Steel Before and After Neutron Irradiation and in the Following Post-Irradiation Annealing by APT and TEM
Y. Du, IMR, Tohoku University 20

C5 Study of Deuterium Retention Property of Irradiated Damage Sample Using Compact Divertor Plasma Simulator for Hot Laboratory
M. Yajima, National Institute for Fusion Science 21

March 3

8:30-10:50 Computational Materials Sceince/Informatics **Chair: M. Kubo**

D1 Advancement of Computational Materials Science with Physics-Based Reactive Potentials
S. B. Sinnott, The Pennsylvania State University 22

D2 Innovation in the Materials Research Through the Integration of First-Principles Calculations and Data Science
Y. Kumagai, Tokyo Institute of Technology 23

D3 Reactive Molecular Dynamics Study on Chemical-Reaction-Induced Deformation of Body-Centered Cubic Iron in Supercritical Water
Q. Chen, IMR, Tohoku University 24

D4 *Ab Initio* Morphology Prediction of Inclusions in Metal Matrix Using Density Functional Theory and Eshelby's Ellipsoidal Inclusion Analysis
A. Ishii, Osaka University 25

D5 Analysis of Atom and Ion Behavior Near Interfaces and Defects Using Machine Learning Potentials
K. Shimizu, The University of Tokyo 26

10:50-11:30 Structural Material I **Chair: K. Fujiwara**

G1 Reverted Interlath Austenite in Stainless Steels
C. C. Tasan, Massachusetts Institute of Technology 32

11:30-12:50 Poster Session (Abstract book Part II)

13:40-16:20 High Magnetic Field and Magnetism **Chair: S. Awaji**

F1 Electromechanical Performance of 2G REBCO Tapes Under Magnetic Field and Fatigue
H-S. Shin, Andong National University 27
F2 Compensated Ferrimagnetism in Heusler Alloys
V. Khovaylo, National University of Science and Technology MISIS 28
F3 Magnetic Properties and Electronic Structures of Half-Metallic Ferromagnets in Heusler Alloys
R. Umetsu, IMR, Tohoku University 29
F4 High Magnetic Field Effects on the Synthesis of Magnetic Functional Alloys
Y. Mitsui, Kagoshima University 30
F5 Recent Progress in Development and Production of Practical 2G-HTS Wires at SuperOx
V. Petrykin, SuperOx Japan 31

16:40-18:10 Structural Material II **Chair: K. Fujiwara**

G2 LPSO-type Magnesium Alloys
Y. Kawamura, Kumamoto University 33
G3 Novel Approach for Strengthening Beta-Ti Alloys Utilizing Diffusionless Isothermal Omega Transformation
N. L. Okamoto, IMR, Tohoku University 34
G4 Slow Strain Rate Tensile Test of a Magnesium Alloy with Polymer-Hydroxyapatite Composite Coatings in Hanks' Simulated Body Fluid
S. Hiromoto, National Institute for Materials Science 35

Program

March 3

11:30-12:50 Poster Session (Abstract book Part II)

P1 Grain boundary segregation of arsenic dopants in silicon crystal revealed by atom probe tomography combined with low-temperature focused ion beam

Y. Ohno, IMR 6

P2 Effect of water quenching on the work hardening behavior of Ti-6Al-4V alloy produced by electron beam powder bed fusion

K. Sri Naga Sesha, IMR 7

P3 Synergistic effects of hydrogen and deformation temperature on mechanical properties of TRIP-aided bainitic ferrite steel

Y. Zhou, IMR 8

P4 Optimization of Continuous Stiffness Measurement Nanoindentation Tests with Berkovich Indenter by Effective Zero-point determination

D. Geng, IMR 9

P5 Development of Ti6Al4V alloys with superior plasticity fabricated by powder bed fusion type additive manufacturing using an electron beam

Y. Gui, IMR 10

P6 Local chemical ordering in CoCrNi medium-entropy alloy and its impact on mechanical properties

K. Inoue, IMR 11

P7 Large antisymmetric interlayer exchange coupling in Pt/Co/Ir/Co/Pt with in-plane spatial inversion symmetry breaking

H. Masuda, IMR 12

P8 $Ln_2Zr_2O_7$ nanopowders, aerogels and xerogels

M. Menelaou, Cyprus Univ. of Tech. 13

P9 Porosity increment of SiC fibers induced by internal oxidation between impurities

X. Yuan, IMR 14

P10 Interfacial Dzyaloshinskii-Moriya interaction in kagome-lattice ferromagnet Fe_3Sn-based multilayers

K. Fujiwara, IMR 15

P11 The Study on Superionic Conductivity of $LiCB_9H_{10}$ by *Ab Initio* and Neural-Net Potential Molecular Dynamic Simulations

R. Sato, AIMR 16

P12 Evaluation of interface bonding strength of explosive welding tungsten-coated ferritic steel using micro double-notch shear test
X. Wu, IMR 17

P13 Effects of Ti-B eutectic sintering aid on the densification of TiB_2
Y. Jimba, IMR 18

P14 Pulsed-laser deposition of single-crystalline ilmenite $MgTiO_3$ thin films
M. Negishi, IMR 19

P15 Isothermal and non-isothermal crystallization kinetics of $Zr_{35}Hf_{13}Al_{11}Ag_8Ni_8Cu_{25}$ High-entropy metallic glass
Y. Ohashi, IMR 20

P16 Synthesis and Thermal Imprint Ability of Nanocrystalline High Entropy Alloy Ribbon
S. Nozaki, IMR 21

P17 High-temperature and high-pressure synthesis of complex hydride containing hydride complex of rhenium with ninefold hydrogen coordination
J. Adachi, IMR 22

P18 Temperature effects of metallization of carbon fiber reinforced plastics by cold spray
J. Sun, IMR 23

P19 Phase separation with ordering in aged Fe-Ni-Mn medium entropy alloy
F. Sun, AIMR 24

P20 Reverse transformation behavior and mechanical property of Fe-0.3N alloy
M. Sato, IMR 25

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Activity Report

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