Institute for Materials Research
Tohoku University

External Evaluation Report 2024

August 2025

Preface

This booklet is the report of the international external evaluation which was made for the Institute for Materials Research (IMR), Tohoku University, in 2024. The external evaluation of IMR has been made approximately every 6 years since 1995: 1st in April 1995, 2nd in November 2000, 3rd in October 2006, 4th in January 2013, 5th in December 2018 and this time was the 6th in November 2024. This 6th international external evaluation was conducted by a committee chaired by Prof. Hatsumi Mori and consisting of five overseas and six domestic members with deep insight into international academic research and industrial applications.

The external evaluation was conducted in two phases. In the first stage, committee members were invited to the international symposium SMS2024 held on November 27 and 28, organized by the IMR. Each committee member evaluated the research activities of IMR researchers, groups, and research centers in the research areas they cover in terms of scientific impact and importance, based on their presentations at SMS2024. As the second step, the committee members met together on November 29 to hear about the overall activities of the IMR from the perspective of its organizational management, and based on the research presentations, hearings, and reference materials, this report on activities was compiled.

The period covered by this external evaluation is from FY2018 to FY2023, after the previous external evaluation. During this period, the Covid-19 pandemic limited global research activities, especially international collaborations. These difficulties were overcome through the efforts of all IMR members. In November 2018, IMR was designated as the international joint usage/research center for material sciences, “Global Institute for Materials Research Tohoku (GIMRT)” supported by the Ministry of Education, Culture, Sports, Science, and Technology, Japan. And a certification of GIMRT was renewed in April 2022 until FY2027. In addition, several new projects have been started and renewed to keep the initiative of research activities in material science. IMR is expected to step forward for the next hundred years with the progress of these projects. Therefore, the present external evaluation will have a particularly important meaning for IMR.

Making full use of the advice and suggestions in this report of the external evaluation, we will further enhance our activities and contribute to the development of materials science and communities. Finally, I would like to thank the external evaluation committee members, and all the IMR people concerned with the external evaluation.

August 2025
Takahiko Sasaki, Director
Institute for Materials Research, Tohoku University

Contents

1. Introduction

This report summarizes the findings of the sixth external evaluation of Institute for Materials Research (IMR), also known as KINKEN in Japanese, of Tohoku University performed over four days from November 26 to 29, 2024.

The external evaluation was based on an on-site investigation conducted during a 4-day on-site visit and the progress report submitted prior to the visit. The last external evaluation had been in 2018. Thus, this external evaluation report presents the findings on the general research activities of IMR conducted during the six-year period from FY2018 to FY2023.

The evaluation followed a request made by Prof. Takahiko Sasaki, the Director of IMR, to the eleven members of the evaluation committee to report on the validity of IMR principles and objectives, whether IMR operates without any problems, whether the present research activities of IMR are performed well, whether IMR sufficiently contributes to industry-academia-government collaboration or to regional society. The mission of the evaluation committee was to rigorously assess IMR achievements and provide advice from a future perspective.

The parameters of the external evaluation requested by IMR are listed in Appendix 1. The evaluation committee comprised the eleven members listed in Appendix 2. The on-site external evaluation program, which includes participation at the 2024 Summit of Materials Science (SMS2024), is presented in Appendix 3.

2. Research institute principles and goal

IMR has a long history. It was founded in 1916 as the 2nd division of the Provisional Institute of Physical and Chemical Research at the Faculty of Science, Tohoku Imperial University and renamed in 1919 as the Tohoku Imperial University-affiliated Iron and Steel Research Institute, with Dr. Kotaro Honda appointed as its director. It was the first research institute in Japan to be established at a university under a government mandate. With the renaming of the institute as IMR in 1922, the research focus of the institute expanded from iron and steel to cover light metals and nonferrous metal alloys. With the incorporation of Tohoku University as a national university in 2004, IMR was designated as an affiliate of the National University Corporation, Tohoku University. In 2010, IMR was certified as a Joint Usage/Research Center for Materials Science. In 2018, IMR was certified as an International Joint Usage/Research Center.

The mission statement of IMR is given below.

"The Institute for Materials Research (IMR) contributes to human civilization and well-being through the creation and application of truly useful materials by research on metals, semiconductors, ceramics, molecular materials, and many others, including its compounds, composites, and structures."

The focus of IMR is on

1. Creating new metals and a wide range of other substances and materials in its capacity as an international Center of Excellence (COE).
2. Educating and developing researchers who will advance materials science in Japan as a core base for joint research in materials science.
3. Advancing the level of applied research in environmental energy, biology, information and communication, high-level safety in life spaces, and other fields of leading-edge materials science and contributing to the sustainable development of our society and human prosperity.

Twenty-seven research laboratories and seven large-scale research centers, along with their research support organizations and administrative offices were evaluated.

The evaluated organizations are listed in Appendix 4.

3. Operations, organization and personnel, infrastructure and budget

(1) Operating organization

The organization structure of IMR is shown in Fig. 1. IMR is responsible for the institute's personnel, research strategies, future planning and safety management, as well as coordination of domestic and international collaborative research by the institute's laboratories and research centers. The success of IMR in achieving its goals depends on the quality of the leadership provided by its director. Since 2018, whenever a new director was appointed, there have been changes in the governance of IMR and the role of the director has been strengthened through collaboration with the executive committee and its offices (Fig. 1). These new developments have led to the implementation of new measures with regard to the staff, laboratories, and centers of IMR. Some research areas were closed, while several new research areas were established, as shown in Fig. 2. For example, a new field of computational material informatics has been proposed. The Center for Neutron Science for Advanced Materials and the Center for Advanced Light Source and Materials Science were integrated to create the Quantum Beam Center for Materials Research; the Trans-Regional Corporation Center for Industrial Materials Research was merged with the Cooperative Research and Development Center for Advanced Materials. The success rate of obtaining external research funding indicates that these organizational changes have been successful. Nevertheless, regular discussions with national and international advisory committees, including industry representatives, are strongly recommended to keep pace with the developments in scientific and societal needs.

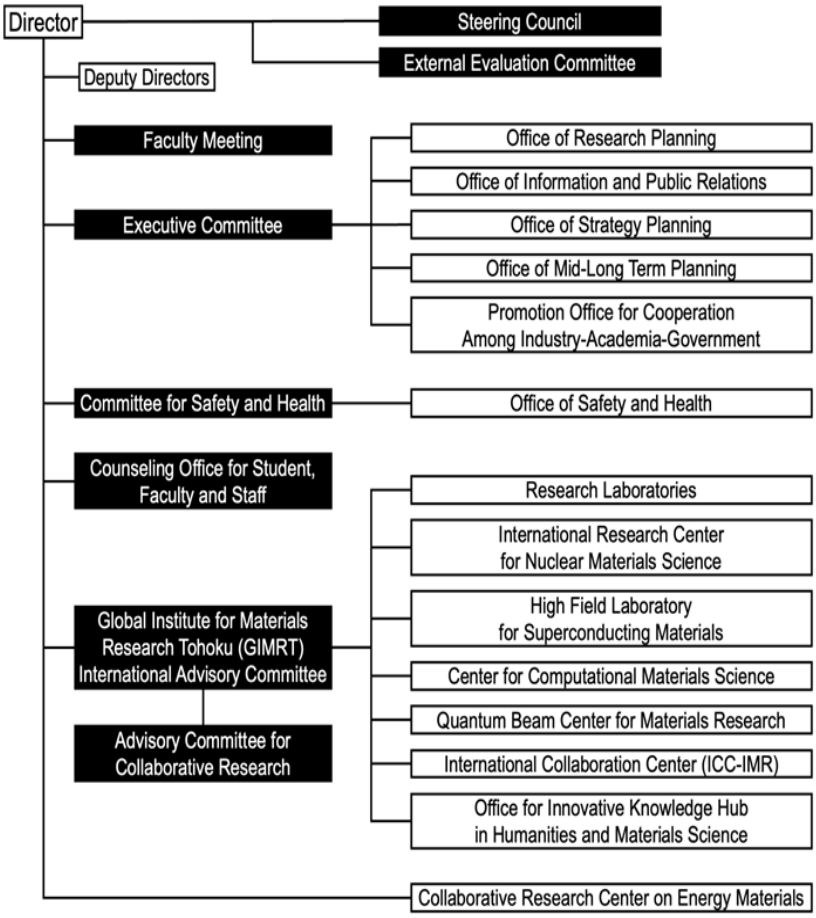

Fig. 1 The organization structure of IMR (Activity Report 2024).

Recommendations

(I) Sustainable development of scientific and societal needs

The activities and functions of the Office of Research Planning, Office of Strategy Planning, and Promotion Office for Cooperation Among Industry-Academia-Government, coming under the purview of the executive committee (Fig. 1), should be reviewed to clarify the roles of the offices and strengthen mutual collaboration. This arrangement will reinforce the role that the executive committee plays in the form of a think tank for the director and help the management of the institute to explore new scientific and social needs.

(II) Status of the institute

A quantitative assessment of the performance of an institute can be conducted using both absolute and relative evaluations. As stated in this activity report, the performance of IMR was evaluated in terms of quality and quantity, and the numbers of papers published, presentations made at domestic and international conferences, and press releases. However, the performance of the institute had to be compared with that of domestic and overseas universities and research institutes that are leaders in materials research. We therefore recommend that IMR introduce a benchmark-based quantitative evaluation method that can be used to survey the world's leading universities and research institutes in the field of materials research.

(2) Research organization

Since its establishment, IMR has been a leading research institute in Japan and has been in the forefront of worldwide materials research. Its research organization integrates traditional research in new directions, considering the current social circumstances and the results of internal and external evaluations, using a balanced approach. How the research organization and centers of IMR have transitioned over the years since 2018 are shown in Figs. 2 and 3, respectively. Twenty-seven research laboratories and seven research centers have been involved in the research activities of IMR.

The research strategy of the current director has been "traditional, yet always new", reinforcing the uniqueness of traditional areas of research (magnetic materials, iron and steel, material processing, and theory of solid state physics) while supporting new research areas and directions, such as advanced electron microscopy and materials informatics.

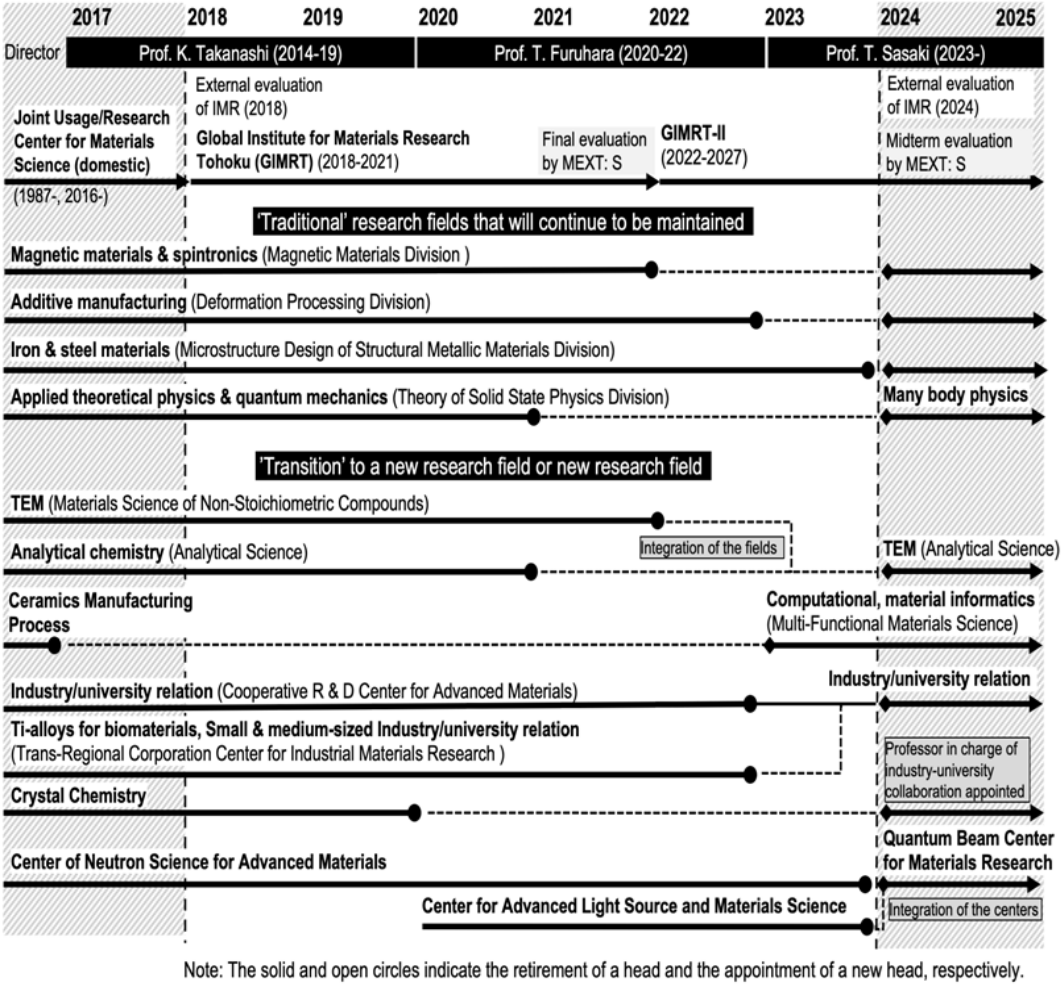

Fig. 2 The transition of research divisions and centers in IMR (Activity Report 2024).

Recommendations

(I) Current research strategy: “traditional yet always innovative”

When implementing his research strategy, the director has to ensure that limited research resources, such as human resources, research infrastructure, and research funds, are effectively allocated based on the research priorities of the institute. Thus, to ensure the sustainable implementation of the strategy, efforts should be made to improve the transparency of the decision-making process in addition to establishing an institute-wide system for identifying scientific and societal needs and formulating strategies to meet them, as recommended under the heading Operating organization.

(II) Institute-wide discussions on challenging and traditional core research areas involving young researchers

A system should be made available that allows the opinions of young researchers who will lead the next generation, to be reflected in discussions on challenging and traditional core research fields.

(3) Faculty and personnel

A distinctive feature of any IMR laboratory is its chair system comprising one full professor, one associate professor, and two assistant professors. This chair system is advantageous for promoting the research capability of a laboratory in terms of human resources, facilities, research funds, and laboratory space; however, some challenges that need to be addressed were identified during the evaluation.

The first challenge is to ensure the smooth transition of the laboratory and its research field upon the retirement of a professor. This smooth transition involves the continuation of the research field or transition to a new field based on the future research strategies of the institute. Since 2018, several full professors have retired. Promising researchers had been recruited to the core ("traditional") areas to continue their research areas, while the "transition" areas had been reorganized according to new topics (Fig. 2). We view this current arrangement as a positive approach that should be continued.

The second challenge is the desire to share research information with other laboratories, as was evidenced at the interviews conducted with young researchers, such as doctoral students and assistant professors, during the external evaluation. This exchange will raise research awareness among young researchers, lead to new research initiatives and positively influence the career paths of the researchers. Thus, the institute will have to take the required initiatives in this regard without relying on individual initiatives.

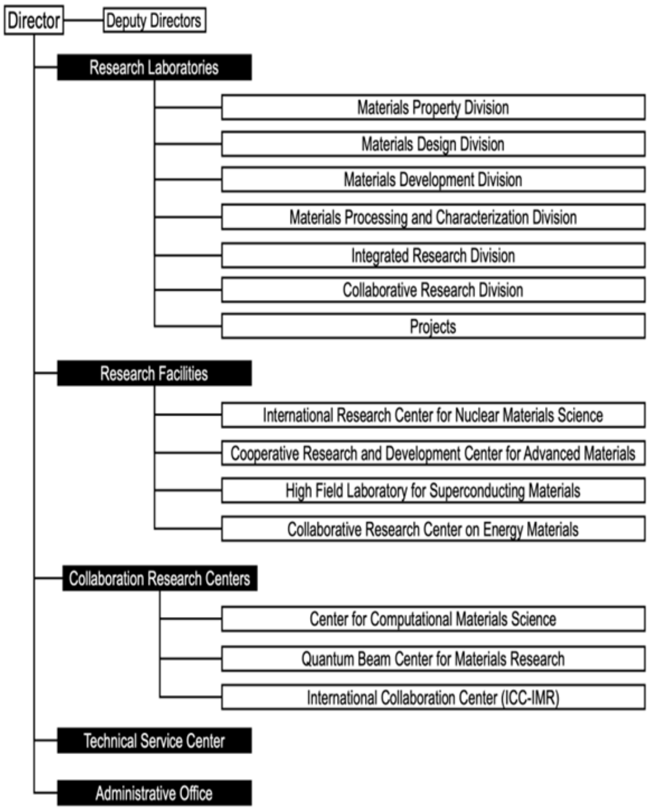

Fig. 3 The organization of research activities in IMR (Activity Report 2024).

Recommendations

(I) Increased diversity and internationalization

As of May 1, 2024, the percentages of female and foreign full-time researchers working at IMR were ~7% (5/70) and ~3% (9/70), respectively. The academic staff included two female full professors but no foreign full professors. (Activity Report 2024) However, to improve the situation, steps, such as appointing Professor Umetsu, a female, as the deputy director, introducing a flexible recruitment scheme for the head of the analytical science laboratory, and implementing the cross-appointment system with overseas universities have been taken. An increase in international collaborative research using the Global Institute for Materials Research Tohoku (GIMRT) and the participation in the International Research Excellence program, which will be fully launched in 2025, are the anticipated future improvements.

(II) Strategy for choosing new research fields after the retirement of a professor

As already mentioned, the leadership provided by the Director, strengthened through collaboration with the executive committee and its affiliated offices (Fig. 1), has led to the success of the institute. To sustain this success, not only the research strategy and achievements of the institute have to be evaluated and reviewed through discussions with the steering committee and external evaluation committee but also an evidence-based evaluation, using the benchmarks created by world's leading universities and research institutes, the competitors of IMR, has to be conducted.

(4) Research support organization

Research conducted at IMR is supported by the administrative office and technical research system, which primarily comprises the Technical Service Center, Analytical Research Core for Advanced Materials (ARCAM), library, and Office of Safety and Health. Technical Service Center has four sections, including six groups, whereas Administrative Office includes General Affairs and Finance departments. As of November 2024, the total number of support organization staff, comprising full- and part-time technical and administrative staff, in service was 135, which is less than the corresponding numbers as of May 2018 (187) and April 2012 (225).

In contrast to 56 in 2018, the support organization staff included 44 full-time technical staff members in 2024, which is noteworthy. The number of faculty members supported by one technical staff member was 2.25 in 2018 and 2.4 in 2024. Although the increase in the ratio is not significant, the workload of a technical staff member had increased during the period concerned, with the material cost remaining unchanged and the scale of the experimental equipment expanding.

Because a reduction in the number of technical personnel could affect the functioning of research facilities and centers, developing a firm support system is important. Thus, in its 2018 report, the review committee highlighted the importance of maintaining human resources and technical capabilities amidst the reduction in the number of technical staff. Therefore, restructuring of the technical staff system to support future research plans will be important. With gradual changes anticipated in the structure of future research, the number, assignments, expertise, and other aspects of technical staff have to be reconsidered to ensure their alignment, in the light of possible reductions in the budgetary allocations for personnel expenses.

Recommendations

(I) Effective human resources

The director and executive committee must determine the optimal number and expertise of technical staff or the optimal ratio between the number of researchers and staff, based on the number of individual laboratories and centers available and reduced budget. This ratio will enable the director to maintain and enhance IMR research performance using the available human resources effectively.

(II) Maintaining in-house staff

Given the unique nature of IMR research facilities, highly skilled in-house technical staff should be maintained as much as possible, while outsourcing should be limited for appropriate purposes. Therefore, enhancing the mobility of technical staff between any two university departments in Tohoku University is worth considering.

(III) Maintaining ARCAM activity

The contribution made by the ARCAM, specialized in the analysis and database management of material data, to advanced materials research is appreciated. The ARCAM is expected to maintain and develop this service.

(IV) Keeping up with digitalization

Because of the increasing importance of the Internet and security measures, along with other digitalization trends, such as artificial intelligence (AI), new initiatives are expected to be implemented in the network office and library.

(5) Research institute infrastructure

Many commonly used apparatus and large-scale specialized equipment, such as high-magnetic-field cryogen-free superconducting magnets, a MASAMUNE-IMR computer system, neutron spectrometers (TOPAN and AKANE), and diffractometers (HERMES), have been successfully installed and used in various centers and laboratories. Large-scale specialized equipment, which most universities do not possess, along with various equipment for analysis, crystal preparation, and materials synthesis, have been actively used in both domestic and international programs. The number and quality of collaborative research projects have increased steadily. In July 2024, the Center of Neutron Science for Advanced Materials and the Center for Advanced Light Source and Materials Science were integrated and named the Quantum Beam Center for Materials Research (QBCMR) to promote collaborative materials research using the unique characteristics of each center. The International Collaboration Center (ICC-IMR) has been actively promoting international research collaboration and exchange in materials science, with its efforts significantly enhanced by the support extended by the GIMRT program. These diverse and persistent efforts have enabled IMR to lead research and development (R&D) of new materials and accelerate domestic and international collaborative research.

Recommendations

(I) Convenience and machine time availability for researchers and joint users

We expect IMR to make continuous efforts to ensure convenience and machine time availability for researchers and joint users across all experimental and computational systems. To achieve this, a thorough optimization and rationalization of operational and maintenance work of the institute, and managerial efforts, will be necessary. Depending on the user circumstances, prioritization of the devices from the viewpoint of return on investment will be necessary.

(II) Understanding the needs of the research communities

Before introducing new equipment and upgrading the existing equipment, IMR should seek to broadly understand the requirements of research communities and industries.

(III) Obtaining funds for cutting-edge devices

IMR, the leader in advancing cutting-edge materials research in collaboration with the industry, should focus on the development of innovative research devices/methods that are not already available. Securing industry and government funds to support these innovations is crucial.

(IV) Enhancing computer systems

Computer servers and relevant computational machines, such as workstations and supercomputers, must provide the best performance to computational materials science users. Considering the balance between the use of in-house computers and external computers while making payments is important. Strategic considerations will also be necessary when using machine learning and informatics because these AI approaches could be the key to innovation.

(V) Organizational support extended to the users

To maintain and strengthen the research infrastructure, both hardware and organizational systems that support user utilization are necessary. Therefore, consideration of the personnel arrangements of engineers and technical staff to avoid excessive burdens on the faculty is essential.

(VI) Development of international recognition

Expanding international recognition of the advanced research facilities and supporting systems of IMR and promoting their collaborative use by overseas researchers is important. We also expect IMR to enhance the international visibility of its experimental infrastructure through the activities of the GIMRT.

(VII) Council decision responsibility

Because these issues are closely related to future development strategies and budget acquisition, the roles played by the councils and committees of IMR are significant. An important responsibility of the councils is to take decisions to optimize the overall research infrastructure of IMR, particularly when different research groups compete.

(6) Budget

Among the research institutes and centers attached to Tohoku University, IMR has the largest budget, which highlights the importance of IMR research activities for the university. Securing the required funds and spending the secured funds to achieve the greatest results within that budget are important. The revenue earned by IMR primarily comprises government subsidies received to meet personnel and non-personnel expenses, as well as KAKENHI (Grants-in-Aid for Scientific Research), commissioned research funds, and joint research funds. Fig. 4 shows the breakdown of the revenue earned between FY2018 and FY2023.

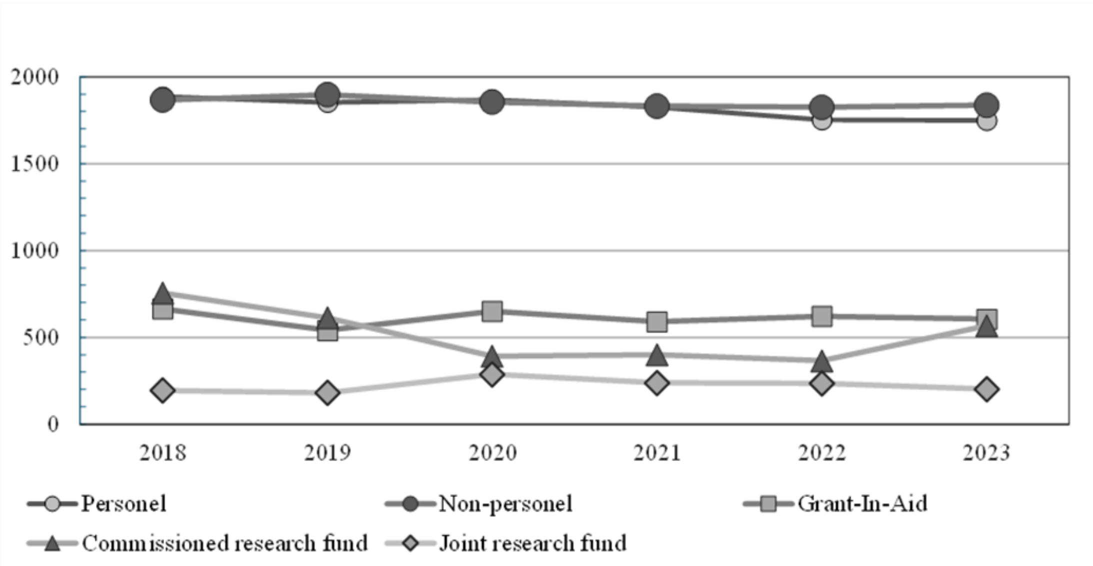

Fig. 4 Budget trend over the past fiscal years (unit: million Yen).

The subsidy received to cover operational, personnel, and nonpersonnel expenses is used almost entirely in meeting those expenses. In line with the policy of the Ministry of Education, Culture, Sports, Science, and Technology (MEXT) that gradually reduces funding (1.6% per annum), the university also has reduced the subsidy it provided to IMR; the amount provided to meet operational expenses has decreased from 5.1 billion yen in 2013 to 3.75 billion yen in 2018. The subsidy provided in 2024 was only 3.59 billion yen.

Research activities conducted by individual research divisions are strongly dependent on receiving KAKENHI, external funds, and joint research funds from the private sector. As shown in Fig. 4, a certain amount of funds has been received by all research divisions, suggesting that they all have been active in conducting research and acquiring research funds through their own efforts. IMR has been receiving nearly 600 million yen per fiscal year from KAKENHI, which suggests that the importance of the research themes has been recognized nationally.

IMR has also received approximately one billion yen in competitive external funding from the MEXT for research conducted jointly with the private sector, indicating the trend for the aggressive acquisition of external funds by each research division. IMR research has been highly trusted by the government and private sector because of its high quality. Furthermore, in FY2024, IMR received a special grant for the installation of a 33-T cryogen-free superconducting magnet.

Thus, despite the decline in the subsidies received for operational expenses, IMR has been able to maintain its financial status at an acceptable level during the period covered by this external evaluation, through external funds it received for active research activities and sound financial management. Even under difficult circumstances, IMR has continued to acquire funds through active operations and research activities, and thus its budgetary efforts in this regard are highly commended.

Recommendations

(I) Maintaining financial stability

IMR has so far been able to sustain itself financially. However, whether it can continue to maintain its financial stability will greatly depend on what it proposes to do. The efforts to secure funding would continue in the future, but the financial situation could worsen in the coming years because of the (i) gradual decrease in the subsidies provided for operating expenses (ii) continuing rise in global prices and utility costs, (iii) anticipated increase in personnel expenses, and (iv) increasing maintenance and renewal expenses of aged experimental equipment and facilities, which will require the operating expenses to be further reduced.

(II) Holding on to the subsidy received from the university

To continue to receive the subsidy from the university for operating expenses, we would request that the value of IMR at Tohoku University be firmly recognized, proactive measures be taken to prevent a significant reduction in the subsidy amount, and any increase in essential expenses be compensated through some measure.

(III) Prioritization in diverse research areas

Given that personnel expenses have already been considerably reduced, making efforts, such as discarding obsolete equipment, reorganizing and streamlining research divisions, and reviewing facility maintenance costs, will be important for restructuring and reducing nonpersonnel expenses. The priority of research subjects, fields, and equipment will have to be determined strictly based on the trade-off between the funding allocated and value added (research results). Special consideration should be given to securing funds for collaborative work with the GIMRT because of the importance of these activities for IMR in its contribution to the research community both within and outside Japan and maintaining their trust in IMR. Currently, only a small percentage of nonpersonnel expenses is transferred to this collaborative work.

(IV) Efforts to secure external funding

Each division must continue with its efforts to acquire funds from KAKENHI and other external sources. IMR should consider it important to ensure that

KAKENHI funds are received for all divisions. Efforts should also be made to acquire government and private funds by facilitating industry–academia collaboration, which would ensure the implementation of IMR research findings.

(V) Gaining industry trust

Building on the trust and strong research foundation earned through outstanding research achievements, IMR will continue to pursue a cycle of research achievements and acquisition of funds; outstanding researchers will generate new, high-quality research findings, which in turn will attract new research funds and enable research development.

(VI) Designation of Tohoku University as a University for International Research Excellence

Tohoku University is now recognized as a University for International Research Excellence, but the impact of this designation on IMR was not presented to the evaluation committee. Because this new designation of the university would have a significant impact on the administration of IMR, its budget plan has to be carefully readjusted to meet the new expectations of the university.

4. Research activities

(1) Current state of research and planning for the future

Materials research at IMR has two main focus areas. One focus area is research on magnetic materials, which started with the development of KS magnet steel by the first director of the Institute Kotaro Honda and proceeded through the development of sendust and amorphous alloys, leading to research on nanocrystalline alloys, spintronics, and spin currents. The other main focus area is research on iron and steel, which was also initiated by the first director Honda. The research continues on special steels, heat-resistant steels, and other metals and the creation of a research stream on structural metallic materials has led to research on other new nonferrous, ceramic, and semiconductor materials. Based on this research history, the IMR contributes to human civilization and well-being through the creation and application of truly useful materials by conducting research on metals, semiconductors, ceramics, organics, and many others, including their compounds, composites, and structures.

IMR has four research divisions, with twenty-seven research laboratories, six research facilities, and eight collaboration research centers. To meet the needs of modern society, IMR has established three interdivisional and interdisciplinary high-priority research areas focusing on energy-related materials, infrastructure materials, and electronic material. IMR is working toward advancing research in all these fields.

The retirement of a principal investigator (PI) is a good opportunity to examine the future of research fields. In IMR, six PIs have retired after 2018. While four research fields, namely magnetic materials, steel, material processing, and solid state physics theory, continued, the two research fields chemical analysis and ceramic processing were discontinued to pave the way for the new research areas of advanced electron microscopy and materials informatics. Although the evaluation committee understands that magnetic materials and steel are the two primary focus areas of materials research at IMR, the committee recommends that IMR consider new directions in these two areas.

Recommendations

(I) Future plans for neutron science and nuclear material research

The evaluation committee believes that neutron science and nuclear material research should be pursued in future.

(2) Research output and information dispatch

Publication statistics, including the total number of publications and number of publications per research staff member, have been gradually declining recently. One major cause for this decline could be the decrease in the number of faculty members, which was approximately 20% within the last four years owing to budgetary constraints. However, several other reasons could also be possible. Thus, detailed analysis and benchmarking have become necessary.

The previous evaluation committee highlighted that many highly valued achievements were issued by the Materials Property Division and Materials Development Division, whereas comparatively few achievements were issued by the Materials Design Division and Materials Processing and Characterization Division. The Committee had stated that IMR executives should carefully examine whether these discrepancies were caused by organizational operations and whether special measures were necessary to address them.

Recommendations

(I) Detailed analysis of the research output

This evaluation committee also recommends that IMR carefully analyze the research activity of each of its divisions using publication data and any other information. Benchmarking against the world's leading material research institutes, such as Massachusetts Institute of Technology, Tsinghua University, Stanford University, University of Cambridge, ETH Zurich, and Max Planck Institutes (for Solid-State Research, and for Sustainable Materials) will help optimize organizational operations.

(3) Collaboration with other departments and institutions

Prof. Nojiri made a presentation on the organization and activities of the GIMRT, an international bridge for multicore collaboration research for establishing international materials-science-related open research alliances between domestic/ overseas researchers and universities/institutes.

The GIMRT offers programs to support researchers using the large facilities operated by IMR. It also offers several types of programs to promote international collaborations. The GIMRT also supports the activities of young researchers. The external evaluation committee was pleased to know that the GIMRT programs promote international collaborations. The committee wishes to commend IMR efforts to monitor GIMRT activities by using suitable indicators and communicating with the international steering committee.

Recommendations

(I) Life Innovation Materials

The previous evaluation committee had commented on the creation of life innovation materials for developing interdisciplinary and international research. We also recommend that IMR study the recommendations made by the previous committee. If any actions are taken, their appropriateness should first be reviewed or else, the IMR should continue to discuss the actions.

5. Educational activities

(1) Undergraduate and graduate education

The undergraduate and Master degree programs at IMR are parts of the broader educational framework of Tohoku University. IMR plays a limited role in the direct improvement of these programs; however, its continued support by providing specialized lectures and research opportunities is commendable. Enhanced collaboration with other departments could lead to improved program alignment and enrichment.

Recommendations

Although the current educational framework of IMR meets the general standards expected of a Japanese university, further development of IMR strategies is essential for nurturing graduates who can lead the global stage. For graduate schools in particular, establishing admission and educational systems that are highly attractive to students with strong potential is essential. Building a sustainable framework that continuously produces talented individuals who can meaningfully contribute to society should be a central priority of IMR.

(I) Feedback

Students have to be listened to. A formal mechanism for obtaining student feedback on educational quality has to be established and prompt action on identified issues has to be ensured. IMR can consider setting up a student consultative committee or union. The students have to be provided with rooms and facilities at IMR. The PIs should actively seek feedback from the students on the effectiveness of their educational activities. If the students express dissatisfaction, PIs should address their concerns with institutional support to ensure continuous improvement of the educational methods adopted at IMR.

(II) Doctoral student decline

The continuing decline in the number of Japanese doctoral students, particularly in graduate schools of engineering, remains a serious concern. This issue is not unique to IMR, but reflects national trends. However, given IMR preeminent research environment of IMR, strategies to attract both domestic and international doctoral candidates need urgent implementation. These strategies can include enhanced financial support, targeted outreach, and collaboration with industries to improve the job prospects of PhD graduates. Support for international students' needs improvement. A recruitment strategy for prominent researchers of each generation is required. Social media, such as YouTube, can be used to attract interest. A seminar series for junior researchers can be organized. IMR-wide talks and lectures.

(III) Graduate program contributions

The participation of IMR in graduate programs is highly appreciated. The programs provide valuable interdisciplinary training and international exposure to students. The continued development and expansion of the programs are strongly encouraged.

(IV) Minimizing additional educational burden

To maintain the high research output of IMR, the PIs should not be overburdened with additional educational responsibilities. Instead, a dedicated educational faculty member should be employed for the teaching-intensive roles, enabling the PIs to focus on mentoring and research guidance.

(2) Development of young researchers

IMR has made commendable efforts to support the development of young researchers through various programs and mentoring schemes. However, further structural enhancements are required to ensure that these efforts promote sustained global leadership. Particularly, fostering a research environment that systematically promotes creativity, independence, and long-term career development is vital. The following recommendations aim to strengthen IMR toward cultivating the next generation of internationally competitive scientists.

Recommendations

(I) Fostering creativity and independence

IMR initiatives, such as the Materials Science School for Young Scientists and the Summit of Materials Science, provide excellent platforms for nurturing creativity and research independence among young researchers. The programs should continue, with increased financial support and broad participation. Necessary steps should be taken to nurture researchers active in global society.

(II) Dedicated educational roles

IMR could consider recruiting faculty dedicated to educational activities, particularly undergraduate teaching and recurrent education, to alleviate the burden on the PIs.

(III) Financial support for young researchers

Only limited financial resources are available for developing young researchers. Strategies to increase funding, possibly through industry collaboration or alumni contributions, should be prioritized.

(IV) Strategic recruitment

A robust strategy has to be developed to attract domestic and international graduate students by focusing on the unique strengths of IMR and cutting-edge research opportunities available therein.

(3) Researchers in the industry

As materials science continues to play a central role in technological innovation, the expectations placed on industrial researchers are rapidly evolving. IMR has to contribute to society not only through academic research but also by fostering lifelong learning opportunities for professionals in the industry. By strengthening its engagement in recurrent education, IMR can bridge the gap between cutting-edge research and practical applications. The following recommendations outline how the role of IMR in industrial human resource development can be strengthened.

Recommendations

(I) Promotion of lifelong learning

Recurrent education is vital to industry professionals for addressing societal demands for continuous skill development. The organizing of open lectures and summer schools by IMR are commendable and should be expanded. In this regard, the committee strongly recommends that IMR should hire dedicated professors specialized in recurrent education. IMR should consider expanding and strengthening its continuing education programs by hiring experts and tailoring the programs to meet industry requirements, which would enhance the societal contributions of IMR.

(II) Alignment with industrial needs

IMR should collaborate with the industry to tailor recurrent education programs to address the latest technological and research advancements.

6. International Joint Usage/Research

The ICC-IMR was initiated in 2008 using funds provided by IMR. It promotes various types of international collaborations in materials science and serves as a gateway to facilitate diverse collaborations between international researchers and IMR scientific staff.

Joint usage/research activities of IMR began in 2018 with the establishment of the GIMRT as an international joint usage/research center for materials science, with support from the MEXT. Through the GIMRT, IMR has presented bridge-type proposals to serve as a hub connecting domestic and overseas researchers, developed a system to send young domestic researchers to overseas institutions for joint research, and arranged individual or team visits to IMR after receiving joint research applications four times a year.

The numbers of international joint research projects of IMR [470 (2016-18) → 597 (2022-23)] and its overseas researchers [40 (2016-18) → 143 (2022-23)] have increased through the establishment of the bridge-type proposal system and strengthening of overseas collaborations through domestic and foreign researchers. Accordingly, the rates of internationally coauthored papers [36.0% (2016-18) → 40.4% (2022-23)] and top 10% international collaborative papers [9.7% (2016-18) → 15.0% (2022-23)], and the number of international joint research projects related to the GIMRT [101 (2016-18) → 119 (2022-23)] have increased. The activities of the GIMRT serving as a hub for international brain circulation, comparable to that of leading overseas research institutions, are highly commended.

Recommendations

(I) Support extended to GIMRT activities

Efforts should be made to obtain increased external funding to expand the GIMRT; however, the GIMRT is supported by IMR research staff and hence tends to compete with individual researchers. The ICC-IMR provides flexible use of funds for collaborations that directly benefit IMR research.

(II) Publicizing the GIMRT

The opportunities available at the GIMRT can be publicized among the relevant audiences, particularly among junior researchers, through large international conferences attended by professors from IMR. This approach would also provide opportunities to obtain informal feedback on how young researchers react to the research opportunities available at the GIMRT.

(III) Encouraging proposals

In the light of budget constraints, encouraging proposals from overseas researchers that provide collaborative benefits to IMR researchers would be desirable. This program will help talented early career researchers to become familiar with IMR and based on positive collaborative experiences; it would provide opportunities for identifying candidates to enhance diversity in recruiting junior faculty positions.

(IV) Optimizing bridge proposals to improve collaboration with other institutions

Bridge proposals allow applicants to use the facilities of IMR and other similar institutions in Japan. It would be practical to look for potential synergies between the global activities of the GIMRT and those of materials science laboratories of other institutions, such as the Institute for Molecular Science and the Institute for Solid State Physics, the University of Tokyo. Advertising such synergies can lead to high-quality proposals.

(V) Communicating research opportunities to young scientists

Students and early career researchers from developing countries can bring enthusiasm and energy to collaborative research projects. Finding effective methods to advertise research opportunities to prospective students and scientists could yield unexpected benefits.

7. Industry-academia-government and society-academia collaboration

Based on Dr. Kotaro Honda's saying that industry is a training ground of academia, IMR has maintained a close relationship with the industries and conducted collaborative research projects with them to commercialize novel materials and provide academic and technical advice to the industries. Annually, over 150 research projects are being conducted in collaboration with private companies. Sixty-five percent of the patents generated by IMR-affiliated researchers between 2018 and 2023 have been shared with private companies.

The development of a TiNbSn alloy for implant stems is an example of technology transfer from IMR to a private company. This titanium alloy comprises elements that are safe for living organisms and has the world's lowest Young's modulus of 36 GPa, which is close to that of the human femoral cortical bone (10–30 GPa). The alloy can be used to suppress disuse bone atrophy caused by stress shielding. The company succeeded in the practical application of the new alloy through joint research conducted with other companies and the Graduate School of Medicine of Tohoku University and succeeded in obtaining pharmaceutical approval for the alloy from the Ministry of Health, Labour and Welfare in 2021.

Various materials, such as KS magnets, sendust, amorphous alloys, and SiC fibers, have been commercialized by IMR. Recently, IMR researchers have established several spin-off venture companies to promote the implementation of their newly developed seed technologies.

IMR conducts lectures on the basics of materials development and current research trends for engineers in private companies for developing the next-generation engineers involved in materials processing and production. The KINKEN Summer School has been held for over 100 years since 1922, and the 94th school was held in 2024.

IMR has also significantly supported the metal manufacturing companies in the Kansai region. The Trans-Regional Corporation Center for Industrial Materials Research [Osaka Center (FY2006–FY2011) and Kansai Center (FY2012–FY2017]), established to contribute to social needs through the transfer of academic output of materials science in collaborative research, has been working with the industries in the Kansai area. The center members responded to various technical inquiries related to materials made by the industry. The center has collaborated with Osaka Prefecture University and University of Hyogo to develop next-generation materials, scientists, and engineers. The Trans-Regional Corporation Center for Industrial Materials Research significantly contributed to solving the material issues faced by the local manufacturing industry, However, the Osaka Center was regrettably closed down in March 2024 after accomplishing its mission. Consulting services provided by the center were handed over to the local government. This decision made by IMR to change its strategy for industry-academia collaboration for the effective reallocation of limited human resources is commendable.

As already mentioned, IMR facilitates cooperation among the industry, government, and academia of Tohoku University Material Solutions Center and promotes the development of novel functional materials by cooperating with the industry, government, and academia and by using the cutting-edge technologies, such as nanometal control, ultrahybrid materials, and quantum-dot fabrication technologies, developed at Tohoku University. The main areas of research at the center are infrastructure, electronics, and energy-related materials. The center closely works with the Head Office of Enterprise Partnerships, Institute of Multidisciplinary Research for Advanced Materials, Institute for Fluid Science, and IMR of Tohoku University. Moreover, the IMR leads the management of the Center for Integrated Nanotechnology Support of Tohoku University, which offers a range of nanotechnology-related facilities to researchers worldwide, in both the academia and industry, for open innovation, particularly by performing structural characterization.

Organization-to-organization collaboration has been promoted and encouraged by the governments in recent years. The Tohoku University Co-creation Research Center for High Functional Metals was established at IMR in February 2024. The objectives of the center are to develop innovative Cu-based alloys and their manufacturing technologies and human resources that can address future challenges.

In order to further improve the productivity of industry-academia-government and society-academia collaborations and to make the collaborations contribute to the improvement of Japan's technological capabilities and societal contribution, the following recommendations are made.

Recommendations

(I) Strengthening the liaison between academia and industry

Strengthening the "bridging" function between industry and academia, accurately grasping the potential needs of companies and society, and reflecting them in R&D strategies are required. Thus, the development of human resources and systems that can build broad and deep intelligence in industry-academia collaborations has become necessary.

(II) Evaluative incentives for joint academic-industry innovations

IMR plans to initiate “inverse innovation” that originates from social needs, as typified by the Design & Engineering by Joint Inverse Innovation for Materials Architecture project. To make the initiative successful, a system that will evaluate the achievements of industry-academia collaboration as achievements of the academia has to be in place.

(III) Building comprehensive organizational partnerships

An organization-to-organization industry-academia collaboration complete with a comprehensive agreement will be preferred by the industry. When industry faces a problem, the universities are expected to provide technological seeds to solve the problem. Also, in organization-to-organization industry-academia collaboration, it is important to consistently work from the idea generation stage to result generation stage.

(IV) Improved accessibility to the cross-sectional knowledge of the academia

To effectively promote organization-to-organization industry-academia collaboration, bridging the gap in perceptions between the industry and academia could be possible. For example, industries need to search for technological seeds that can solve their problems. However, they would not be able to grasp the technological seeds in academia. A system that efficiently searches for technological seeds across universities will make it easy to access the desired technologies and researchers.

(V) Fostering cocreative collaboration

The difference in the incentives offered by industry and academia is a challenge that has to be addressed. In other words, while the goal of industry in fostering industry-academia collaboration is to create new businesses and develop new products, academia considers it important for individuals to achieve research results by conducting research and publishing papers. In addition, the time span required by industry for research differs from that required by academia, which can result in differences in the target dates set for solving problems. What is important is to design and manage projects that bridge the gap in perception between industry and academia. The ideal scheme is cocreation in which both industry and academia are involved in building a vision to achieve. To accomplish the scheme, it may be necessary not only to identify the objectives faced by industry but also to set up a forum where the entire university can determine the social value that companies should create.

8. Research activities of the laboratories and centers

(1) Condensed matter physics and fundamental materials sciences

Prof. Onose joined IMR in 2018. His group succeeded in demonstrating the control of chirality in helimagnetic metals by combining a magnetic field and an electric current. He successfully trained six students pursuing Master of Science degrees and three students pursuing doctoral degrees.

Prof. Fujita has led the successful and productive Japan Research Reactor (JRR)-

3 neutron-scattering program, particularly after its restart in 2021. His group has published eighty-seven papers in the last six years on topics such as spin correlations in cuprate superconductors and the direct measurement of magnon polarization with spin-polarized neutrons. However, he faces a challenge in maintaining adequate support for his obligation to operate three instruments (two triple-axis spectrometers, TOPAN and AKANE, and one neutron diffractometer, HERMES) at JRR-3 and to support the collaboration with High Energy Accelerator Research Organization (KEK) on the POLANO instrument at the Japan Proton Accelerator Research Complex (J-PARC). At present, each of his three junior professors supports one of the instruments for which he/she has to commute to Tokai for a reactor schedule of 7 x 25-day cycles per year. (All beam times have to be supported; approximately 30% of the beam time can be accessed for IMR research.) For POLANO, a technical staff member stationed in Tokai is working to develop a spin-exchange optical pumping device for the spin polarization of the neutron beam. The instrument staff handling POLANO are from KEK, and they can access the instrument on 30 days/year. Prof. Fujita has requested the services of an associate professor who will be stationed in Tokai; IMR funds have been granted for a period of no more than five years, and recruitment is in progress.

Prof. Nojiri has made an international impact through the development of unique high-field pulsed magnets that have been used at synchrotron and neutron facilities, including the Stanford Linear Accelerator Center and Institute Laue-Langevin. This impact has enabled the study of novel magnetic field-induced phase transitions. His group has produced 110 publications in the last 6 years. Prof. Nojiri's retirement is anticipated in 2027.

Prof. Sasaki's laboratory has studied correlated-electron phenomena in organic compounds and electrical conductivity in polymer films. They have published 51 papers in the last 6 years.

Prof. Aoki and his group performed intensive studies on the multiphase superconductor UTe_2 in close collaboration with scientists at Grenoble. This work has produced 12 graduates with masters or doctoral degrees in the last six years. The evaluation committee congratulates Prof. Aoki for winning the 2024 Nishina

Memorial Prize.

Prof. Nomura joined IMR in 2024 and initiated his theoretical research program in quantum many-body physics; he fills the position previously held by Prof. Bauer.

Recommendations

(I) Stabilized support for the neutron scattering program at JRR-3

It would be beneficial to find long-term funding to support Prof. Fujita's neutron scattering program. For example, it would be advisable to have another technical staff member to support the operations. As an alternative arrangement, the support extended to one of the JRR-3 instruments can be withheld, and a new owner found. However, neutron scattering is a major part of the experimental resources available from the Quantum Beam Center for Materials Research; therefore, if the proposed arrangement becomes successful, it will have broad implications.

(II) Preparations for the anticipated transitions

Planning for the transition that will occur with the anticipated retirement of Prof. Nojiri in 2027 has to start. A transition has already occurred at the High Field Laboratory for Superconducting Materials for which a new head was hired in FY2022; however, Prof. Nojiri now leads the ICC-IMR. High-field magnets and international collaborations are important facets of IMR research that require strong leadership.

(2) Structural and nuclear materials

Fundamental studies have been conducted in five laboratories to enhance the performance of structural materials. Nuclear materials, steels, and alloys are the major targets. Remarkable results have been achieved through advanced analytical techniques, microscopic observations, new fabrication technology adoption, and unique theoretical considerations.

Prof. Nagai has been working to elucidate the mechanism of neutron-irradiation-induced embrittlement in reactor pressure vessels using microscopic observation techniques, such as transmission electron microscopy and atom probe tomography. He has also conducted similar studies on fusion and other materials. His remarkable study findings would contribute to the technological and material science fields. Prof. Kasada has been working on the development of new materials with enhanced resistance for use in extreme environments, particularly focusing on oxide dispersion-strengthened alloys (ODS) and the development of accident-tolerant fuels, as the major targets. With respect to ODS, research focusing on nano-oxide-particle dispersions has produced good results in the last few years. Prof. Furuhara's laboratory has been conducting numerous outstanding studies aimed at clarifying the principles of microstructural evolution of metallic materials, particularly steels. The major research themes of the laboratory include 1) a light element strategy for advanced designs of high-strength, high-ductility steels by understanding the atomistic interactions, 2) phase transformations that occur during thermomechanical processing, and 3) the development and application of advanced multiscale characterization techniques. Prof. Akiyama has been studying hydrogen embrittlement mechanisms, evaluation methods, and corrosion behaviors in radiation environments to ensure the safe and secure use of structural materials. The research topics have recently gained significant attention because of the growing demand for advanced high-strength steels that are prone to hydrogen embrittlement and essential for creating a hydrogen society. Prof. Yamanaka has been developing advanced processing technologies for metallic materials with primary focus on additive manufacturing using electron beam powder bed fusion. He has published many remarkable papers and some of his research findings have already been practically applied.

Recommendations

(I) Focus on implementing research findings in the industry

Successful research trends must be maintained and developed. However, the implementation of research outcomes in industry has to be focused on. The improvement of the durability and reliability of materials used in nuclear and industrial systems has become important.

(II) Gathering talented young researchers

To sustain and enhance the performance of each laboratory at IMR, highly talented graduate students and postdoctoral fellows from Japan as well as outside have to be recruited. Therefore, the active promotion of student recruitment is required. High research performance must be achieved to educate graduate students and build an international reputation for IMR. The number of high-quality research papers in particular must be further increased and comparatively evaluated against those of other renowned research institutes.

(III) Continuing nuclear materials research using aging facilities

The nuclear policy in Japan being unclear, nuclear materials research has become problematic. However, research on materials applied in extreme environments, those used in nuclear applications in particular, will be required. On the other hand, relevant professors are expected to streamline the use of aging radioactive facilities to reduce the burden on researchers responsible for ensuring the safety of the facility.

(3) Frontier materials and computational materials science

IMR has made significant strides in frontier materials and computational materials science, with multiple laboratories and centers demonstrating a strong interdisciplinary integration of theory, simulation, and experimentation. Notably, the shift in ceramic research from a processing-centric approach to one that embraces computational modeling is a welcome development. The Center for Computational Materials Science and Materials Design by Computer Simulation Research Laboratory have developed large-scale and multiphysics simulation platforms to address real-world problems associated with tribology, catalysis, fuel cells, and corrosion. Furthermore, the contributions made by IMR to machine-learning-based materials modeling, quantum many-body physics, and integration of theoretical and experimental validations, in superconductors and spin liquids in particular, reflect the maturing ecosystem of computational and theoretical excellence.

Theoretical solid state physics combined with material simulations and the availability of large-scale computational resources, such as Fugaku and MASAMUNE-IMR, are major research assets. However, fostering deep cross-laboratory collaboration and using computational advances in material synthesis and processing remain challenging.

Recommendations

(I) Strategic integration of computational and experimental efforts

Despite the world-class individual computational groups that IMR possesses, a more integrated framework that can systematically bridge simulations with experimental validations across the laboratories is recommended. Establishing cross-divisional thematic teams or flagship projects could catalyze such integration and maximize the impact of computational predictions.

(II) Enhancing cross-disciplinary communication

To foster interactions among researchers dealing with solid-state theory and large-scale materials simulations, IMR should organize regular internal symposia, workshops, and collaborative pilot projects. These efforts would help align theoretical insights with practical material design challenges.

(III) Expansion of materials informatics and artificial intelligence initiatives

Building on recent achievements in machine-learning-based modeling, IMR should invest in training young researchers in materials informatics and apply AI-driven discovery to underexplored domains, such as disordered systems and defect chemistry. A dedicated research unit or a center focused on materials informatics could serve as a national and international hub.

(IV) Establishment of long-term benchmark projects

To evaluate its progress and promote open collaboration, IMR could launch long-term benchmark simulation and modeling projects, such as open challenges in structure-property prediction, involving both domestic and international partners. This type of an initiative would help solidify IMR leadership in computational materials science and attract global talent.

(4) Energy-related materials

Energy-related materials are among the three high-priority research areas at IMR. While no coordinated research on energy-related topics relevant to the future energy economy has been conducted at IMR, some research units, particularly those involved in materials research, have significantly contributed to energy science. The contributions made by IMR to the fundamental aspects of hydrides and applications of hydrogen storage materials have received global recognition and appreciation. Furthermore, work on new battery materials, such as complex hydrides used as solid-state electrolytes, is of great importance for Japan's battery industry. Research on the magneto-thermoelectric effect of a topological magnetic material has revealed that the material is capable of thermoelectric conversion, even in a zero magnetic field. A porous material, which becomes magnetic when it adsorbs carbon dioxide, could lead to a magnetic switch using gas adsorption. Research and development on materials resistant to extreme environments will be the key to the realization of the next generation energy sources, such as fusion reactors or advanced fission nuclear power systems.

Several exceptional research activities in energy-related fields were noted; however, a research strategy for energy materials has not yet been formulated. No research has been conducted on synthetic fuels or biomass although they are energy-research-related topics that could become important in the future energy transitions. New material challenges are introduced with the substitution of fossil fuels with renewable energy. There could be new research opportunities to which IMR can contribute and position itself.

Recommendations

(I) Fostering research on social and industrial impacts

IMR can pursue promising materials strategies and develop innovative materials for significant energy, carbon, and economic benefits.

(II) Building research fields based on long-term strategies

IMR can strategically create materials technologies and research areas important for the future energy transitions.

(5) Functional materials and superconducting materials

The solid metal coordination chemistry group, led by Prof. Miyasaka, conducts materials research to control the physical properties of porous materials by utilizing the chemical interactions induced by the adsorption and desorption of gas molecules in the pores of metal-organic frameworks (MOFs). Many interesting discoveries, such as the transition from a ferrimagnetic phase to an antiferromagnetic phase due to the adsorption and desorption of oxygen gas molecules and the discovery of the chirality-dependent circular photogalvanic effect in two-dimensional organic-inorganic hybrid perovskites, have been made. Their study findings have been published in international academic journals with high impact factors and have also been announced in the press. Control of the novel physical properties of MOFs induced by chemical interactions between MOFs and gas molecules or inorganic layered materials has attracted considerable attention from both academia and industry. Research on the selection of chemical bonds between MOFs and adsorbed substances under the physical influence of the MOFs is ongoing. For example, selecting or sensing gas molecules adsorbed on MOFs by utilizing the changes in external fields, such as magnetic fields, is being studied. The magnetic materials group, led by the former head of Prof. Takanashi, is working on fundamental research on the physical phenomena of magnetism and spintronics and has been successful in the areas of spin orbitronics, antiferromagnetic spintronics, and spin caloritronics. Prof. Seki, who became the head of the magnetics group in 2024, focused on the long-range exchange interactions between the magnetic layers in artificially created multilayer films, aiming to artificially manipulate their magnetic order. By focusing on artificial thin films rather than bulk materials, Prof. Seki is now working on new spintronics materials and has obtained notable results, such as the availability of spintronics devices using artificial antiferromagnets and the discovery of highly efficient thermoelectric conversion phenomena utilizing the anomalous Nernst effect of metallic artificial lattices.

Recommendations

(I) Development of interactive control of chemical and physical properties of MOFs.

The research achievements of the solid metal coordination chemistry group would lead to original research through the mutual control and selection of the chemical bonds of absorbed gas molecules and the physical properties of MOFs, underscoring the importance of conducting chemical research at the IMR.

(II) Exploring the new field of spintronics

Being a key laboratory of the IMR, the Magnetic Materials Group is expected to contribute to new developments in spintronics.

(6) International Research Center for Nuclear Materials Science

The number of joint-use research proposals and published papers increased in the years following 2018 in relation to the corresponding number in the years before 2018, which can be attributed to the successful revitalization of joint-use research. The center has provided valuable research opportunities for joint users, which is appreciable. However, in contrast to the increasing trend in the number of papers on actinide physics, a slightly decreasing trend can be seen in materials irradiation. The absence of a domestic irradiation reactor makes it difficult to obtain new results for the irradiation of materials. The fees for irradiating overseas reactors are increasing and the responsibility that the center has to shoulder in supporting the reactors is growing. In addition, from the viewpoint of safety and maintenance, the aging of radioactive facilities handling irradiated samples has worsened.

Recommendations

(I) Improving the efficiency and safety of radioactive facilities

To maintain and enhance the functions and efficiency of the center, its operations have to be streamlined. To enhance the efficiency and safety of the center, the analytical function of the irradiated samples can be transferred to the Katahira area.

(II) Further development of condensed matter physics using heavy nuclides

The Actinide Experimental Facility should continue to operate as a domestic and international center for developing joint usage/research with an intensified focus on condensed matter physics using heavy nuclides. The facility is expected to be used in chemical studies related to radioactive waste analysis, thereby contributing to new applications. Consideration is also needed for the management of radioactive waste accumulated over the years.

(III) Radioactive facility management aligned with the university plan and research community wishes.

Radioactive facility management would be conducted based on the needs of domestic joint usage/research communities. It has to be in line with the plan prepared by Tohoku University to integrate its radioactive research facilities to avoid unnecessary burdens on KINKEN while adhering to the mission of the center and focusing on value-added research.

(7) Cooperative Research and Development Center for Advanced Materials

The Laboratory for Developmental Research on Advanced Materials was established at IMR in 1987. It was renamed as Cooperative Research and

Development Center for Advanced Materials (CRDAM) in 2013 and has three main divisions: Joint Usage & Joint Research Division, Core Research Division, and Industry-Academia Collaboration Promotion Division. The CRDAM is divided into several research divisions, namely Materials Creation, Function Design, Structure Control, Industry-University Research Divisions, hosting visiting professors and collaborative research support stations (Materials Synthesis, Performance Evaluation, Crystal Preparation) as technical centers. The functions of the CRDAM are as follows: 1. Accelerating the R&D of new materials, processes, and evaluation technologies developed by IMR, using CRDAM equipment, personnel, and other resources, to achieve industrialization and 2. contributing to the development of materials science by providing a wide variety of equipment (fabrication and evaluation equipment) and services of experts (faculty and technical staff) to researchers in Japan and overseas, as a GIMRT organization.

The research output (excluding adjunct members) has been nearly constant over the last 6 years and consisted of approximately 28 papers per year, a few patents, and awards received by the five PIs. The budget increased slightly in 2022 to 40 M JPY in 2024. The number of papers (joint usage/research) published per year was approximately 70.

The center is expected not only to study how to implement the seed technologies obtained at IMR but also to create human resources and opportunities that can break down the diverse needs of society and appropriately connect them with other experts and researchers within the university.

The following recommendations are for the future development of the center.

Recommendations

(I) Strength of the target materials at the CRDAM

As done in the past for amorphous alloys, metallic glasses, and nanocrystalline soft magnetic materials, the CRDAM should determine the target materials that will be its axis of research, accelerate R&D using its resources, and aim for practical applications, such as additive manufacturing and energy technologies, in collaboration with Collaborative Research Center on Energy Materials (E-IMR).

(II). Research equipment renewal

Upgrade aging, large equipment to improve the research and development of CRDAM and GIMRT users from the bottom up.

(III) Sustainable development of human resources

The staff vacancies have to be filled and the R&D structure of the CRDAM has to be established.

(IV) Defining the objectives of the CRDAM

The CRDAM organizational structure has to be revised to 1. strengthen the contributions to the GIMRT; 2. stimulate industry-academia collaboration activities, and 3. strengthen cooperation within the CRDAM organization.

(V) Creating a cooperative system

The key points for future collaboration will be to set up a permanent office where small and medium-sized enterprises can receive advice and actively approach the industry and government through the center. It will also be important to create a cooperative system that transcends the boundaries of not only the Institute for Metals but also the various departments of Tohoku University.

(8) High Field Laboratory for Superconducting Materials

The evaluation committee understands that the cryogen-free 25-T superconducting magnet has been steadily operating and that it is widely used by many domestic and foreign researchers. Since the launch of the GIMRT, the number of overseas users of the magnet has increased. User time also has significantly increased, which could significantly contribute to producing high-quality data on superconducting critical fields, Fermi surfaces of metals, and magnetic-field-induced phase transitions.

The installation of a new cryogen-free 33-T superconducting magnet has begun, which is noteworthy. The design of $ReBa_2Cu_3O_7$ superconducting wires will be useful not only to IMR but also to worldwide high-magnetic-field facilities.

The evaluation committee understands that IMR will complete the installation of a 31-T hybrid magnet in March 2025. Although the number of publications has been decreasing since 2021, a possible major cause of it can be the nonoperation of magnets. The situation is expected to normalize soon with the steady operation of magnets, including the 33-T magnet. We are pleased to note that the center has prepared a mid-term plan for the development of a 40-T superconducting magnet.

Recommendations

(I) Becoming a world-leading High-Field Laboratory

The laboratory has long played the role of a world-leading high-field research center. The evaluation committee recommends that IMR should continue to support the installation of the 33-T superconducting magnet. It also expects that IMR will continue work toward the successful implementation of its mid-term plan.

(9) Center for Computational Materials Science

The Center for Computational Materials Science (CCMS) at IMR continues to serve as the cornerstone of the IMR efforts to develop and apply advanced simulation technologies to materials research. During the previous evaluation period, the center has led pioneering efforts in multiscale, multiphysics simulation platforms and has demonstrated its strength in applying large-scale atomistic and reactive molecular dynamics simulations to areas related to tribology, corrosion, catalysis, fuel cells, and high-temperature materials. The successful use of billion-atomic-scale simulations to model chemical degradation and tribochemical reactions demonstrates the advancements made in computational materials science.

The center also plays a vital role in developing simulation methods that bridge physical and chemical phenomena across multiple length and time scales, leveraging supercomputing infrastructures, such as Fugaku and MASAMUNE-

IMR. Collaborative work with experimental groups further enhances the credibility and relevance of the results. However, to sustain international leadership and broaden its impact, strategic coordination across IMR divisions and the expansion of academic-industry partnerships will be essential.

Recommendations

(I) Promoting cross-dimensional simulation platforms

The CCMS should continue to act as a catalyst for integrating computational approaches across IMR divisions by promoting common simulation frameworks and accessible tools. It will enhance data exchange and encourage the widespread use of advanced simulations in experimental laboratories.

(II) Strengthening human capital in computational materials science

To sustain its global competitiveness, the center should continue investing in the training and recruitment of young researchers with expertise in high-performance computing, machine learning, and advanced simulation methods. Joint Ph.D. programs or short-term fellowships conducted in collaboration with international institutions would help attract and retain talent.

(III) Enhancing collaboration between experimental and industrial partners.

The CCMS should deepen collaborative efforts with experimentalists within IMR, as well as with external industrial partners. Codesigned research agendas, including digital twin approaches and predictive modeling of processing-structure-property relationships, can amplify the societal impact of the work of the center.

(IV) Establishment of open simulation benchmarks and databases

To enhance the visibility and reproducibility of its work, the CCMS can initiate open benchmark projects or use public databases based on large-scale simulations. This would reinforce the leadership of the CCMS in the field and support a wide materials community.

(10) Quantum Beam Center for Materials Research

The dedicated beamlines of J-PARC and JRR-3 at the Center of Neutron Science for Advanced Materials (CNSAM), which had been suspended owing to the Pacific Coast of Tohoku Earthquake that occurred in 2011, were reopened in 2019, and with the start of the GIMRT program in 2019, the number of collaborative research proposals received from researchers in Japan and other countries has increased. However, concerns have been expressed that there will be a shortage of personnel to maintain equipment and support beamline users with any further increases in collaborative research. Currently, this issue is being addressed by adjusting the allocation of device usage time; however, sustainable solutions are urgently needed.

The QBCMR was created in FY2024 by merging the former CNSAM with the Center for Advanced Light Source and Materials Science, initiated in 2020. The QBCMR is well motivated and provides researchers with access to both neutron and X-ray experimental techniques and encourages combinations of these techniques to address research problems. Education and training in these techniques has significant overlaps, and neutron and X-ray techniques can be complementary.

The strong asymmetry in the annual availability of beam time (and dedicated IMR faculty) for the two probe types of the order of 700 instrument shifts for neutrons vs. 8.5 instrument shifts for X-rays is challenging. Although neutron experiments often require more time than X-ray experiments, the difference should not be a factor of 10.

The available beamtime at NanoTerasu is on seven coalition beamlines. IMR is a part of the coalition, which is good; however, this would allow for a limited number of experiments per year. Access through general user proposals will be possible for the three public instruments when they start to operate; the proposal acceptance rate will depend on the level of competition for general user time. Other facilities, such as SPring-8, could be accessed, but the proximity of NanoTerasu to IMR has to be noted.

Recommendations

(I) Evaluation of the X-ray access requirements

The extent of X-ray accessibility for an optimal Quantum Beam Center has to be evaluated and a plan for achieving it should be developed. Whether the ability of the center to provide training can be leveraged in some way has to be explored.

9. Summary and recommendations

As an international center of excellence in materials science, IMR is committed to contribute to the advancement of science and the well-being of humanity through both basic and applied research.

In terms of research related to the GIMRT program, IMR has an international coauthorship rate of 40.4% for its publications and a top 10% rate of 15.0% (2022-2023) although the number of papers has declined slightly. These statistics and the SMS2024 reports demonstrate that IMR has produced high-level research activities as an international joint usage/research center, leading research in the field of materials science and making efforts to nurture the next generation.

In addition, based on the philosophy of Prof. Kotaro Honda who said that industry is the training ground for academics, since its establishment, IMR has actively promoted joint research and commissioned research with private companies totaling 906 million JPY (FY2023), registered 96 patents (FY2018-2023), and established summer schools for engineers.

For IMR to achieve further development and become a world-class core research center for materials science, the evaluation committee wishes to present the following summarized recommendations.

Recommendations

1. Research

(I) Research Strategy

Developing a research strategy under the leadership of the IMR Director is important. In some areas (particularly in steel), IMR has become a national resource. In future, good linkages will be established between steel research and new research areas, such as computational science. The shift in the emphasis of ceramics research from processing to computation is a good example. The Steering Council and the International Users Committee of IMR should develop a scientific strategy in this regard.

(II) Research Budget

As budgets become tight, it becomes necessary to streamline, set priorities, focus on new programs, and use resources effectively. Maintaining a given number of faculty members when financial resources are declining will be challenging. Therefore, the selection and concentration of research subjects will be necessary in each field. Radioactive facility management in the Oarai Center has to be aligned with the university plan and research community wishes.

(III) Networking with other materials science institutions

Network formations across organizations for scientific research and joint usage/research with other joint usage/research institutes, such as the Institute for Solid State Physics at the University of Tokyo, Institute for Molecular Science, Institute for Chemical Research at Kyoto University, Institute of Materials Structure Science of KEK, and National Institute for Materials Science, are important for developing research in the field of materials science.

(IV) GIMRT program activities

The GIMRT program is successful, but needs to be careful not to take effort from other activities. Therefore, its efforts should be concentrated and selective, focusing only on high-quality projects.

2.Education

(I) Nurturing students

To nurture students, PIs in IMR should listen to them, consider setting up a student consultative committee or union, provide student rooms and facilities at

IMR, and extend increased support to international students.

(II) IMR should formulate recruitment and nurturing strategies for researchers who play an active role in global society

To recruit prominent researchers from each generation, it is recommended that social media, such as YouTube, be used to attract interest. It is beneficial to organize a series of seminars, summer schools for junior researchers, and IMR-wide talks and lectures.

3. Gender and national diversity

(I) Increase the number of female students, researchers, and staff

Increasing the number of women and international faculty members serving at IMR is crucial. It is recommended to start with the appointment of three female associate professors by building a strong strategy, such as tenure track, broadening scientific fields, and establishing active contact. Networking meetings and support to female students and researchers will also be effective. An increased number of open international positions will be required to ensure international diversity.

4. Relationship between social and IMR

(I) Flexible human resource mobility between IMR and other institutions

Ensuring flexible human resource mobility between IMR and other institutions, such as universities, research institutes, and companies in both Japan and overseas, is necessary. The promotion of industry-academia collaborative research is important. Therefore, the gap between fundamental research and industrial requirements has to be reduced.

Appendices

Appendix 1 Evaluation parameters

1. Objective

Institute for Materials Research has the philosophy of "contributing to the development of civilization and the well-being of mankind by creating new materials that are truly useful to society by conducting both fundamental and applied research on various materials, such as metals, semiconductors, ceramics, compounds, organic materials, and composite materials." The purpose of this external evaluation is to have the International External Evaluation Committee objectively evaluate the activities of the institute from the following perspectives and obtain advice, thereby establishing a direction for further development as a global core research center in materials science.

2. Evaluation indicators

➢Are the mission and activity policy appropriate for a global core research center in materials science?

➢Are the organizational management and budget effective and sufficient to achieve the mission?

➢Are the research results produced appropriate for a global core research center in materials science?

➢Is the institute demonstrating leadership in the domestic and international materials science community and contributing to the development of the community?

➢Is the institute contributing to the development of the field of materials science through human resource development that leads to research?

➢Is the institute demonstrating an international presence in the field of materials science through international joint research and international exchange?

➢Is the institute able to contribute to the results of its research to society through industry-academia collaboration and social contributions?

➢Are the future plans and visions appropriate for further development as a global core research center in materials science?

3. Specific perspective of evaluation

(1) Operating, organization and personnel, infrastructure, and budget

1-1 Is the organization managed to maximize the results or effects of research, education, and social contributions?

1-2 Is the implementation structure of research divisions and research laboratories, research facilities, collaborative research centers, service divisions, etc. sufficient as a global core research center in materials science?

1-3 Is the research and education environment sufficient to maximize the results or effects of research, education, and social contributions?

1-4 Is the budget and its acquisition sufficient to operate the organization as a global core research center in materials science?

(2) Research Activities

2-1 As a global core research center for materials science, are the academic research results sufficient?

2-2 As a global core research center for materials science, are joint research activities with domestic and international universities and research institutes being conducted appropriately?

2-3 Are the initiatives to contribute to the development of materials science research sufficient?

(3) Educational Activities

3-1 Are education and research initiatives for graduate students, young researchers, and researchers in industry being appropriately implemented?

3-2 Are the effects of education and research for graduate students, young researchers, and researchers in industry sufficient?

3-3 Is the institute responding sufficiently to Tohoku University's initiatives in education, research, and social contribution activities?

(4) International Joint Usage/Research Center

4-1 Are international joint research projects being continuously conducted, and have sufficient results in terms of quantity and quality?

4-2 Are international exchanges actively conducted and continuously promoted?

4-3 Are international exchange and international human resource development sufficiently promoted?

4-4 Has the institute gained international recognition in the field of materials science through international joint research, etc.?

(5) Industry-Academia-Government Collaboration and Society-Academia Collaboration

5-1 Are there sufficient joint research activities with private companies?

5-2 Are appropriate efforts being made to turn research results into intellectual property?

5-3 Are sufficient efforts being made for social implementation of research results, including the establishment of industry-academia-government collaboration system?

5-4 Are there sufficient measures other than joint research to promote industry-academia-government collaboration?

5-5 Are there sufficient educational activities for students and the general public?

(6) Overall Evaluation

What are the issues that need to be addressed for further development as a global core research center for materials science? What is the ideal future vision of IMR

Appendix 2 Evaluation Committee members

International External Evaluation Committee members (Alphabetical Order),
* Chairperson

Dr. Takahisa ARIMA, Professor, Graduate School of Frontier Sciences, The University of Tokyo/Director, RIKEN Center for Emergent Matter Science
Dr. Lindsay GREER, Professor, Department of Materials Science and Metallurgy, University of Cambridge, UK
Dr. Kaori KAWANO, Fellow, Technology Development Division, Nippon Steel Corporation
Dr. Young-Kook LEE, Professor, Department of Materials Science and Engineering, Yonsei University, Korea
Dr. Eiichiro MATSUBARA, Professor Emeritus, Kyoto University
*Dr. Hatsumi MORI, Professor, The Institute for Solid State Physics, The University of Tokyo
Dr. Isao TANAKA, Professor, Department of Materials Science and Engineering, Kyoto University
Dr. John M. TRANQUADA, Senior Physicist, Brookhaven National Lab, USA
Dr. Hajimu YAMANA, President, Nuclear Damage Compensation and Decommissioning Facilitation Corporation
Dr. Roser VALENTI, Professor, Institut für Theoretische Physik, Goethe-Universität Frankfurt, Germany
Dr. Andreas ZÜTTEL, Professor, École polytechnique fédérale de Lausanne (EPFL), Switzerland

Appendix 3 Evaluation Committee on-site investigation schedule

26th Nov. Tue.

(Honda Memorial Building, 3F, MT room + Online)

16:00 About the external evaluation and the contents (Director, and Prof. MORI)

（Explanations on advance distribution materials, SMS2024, and the committee meeting. Confirmation of responsibility, etc.）

17:00 Break 15 min.

17:15 Site visit to High Field Laboratory for Superconducting Materials (Prof. NOJIRI)

17:45 Close

27th Nov. Wed.

(Honda Memorial Building, 3F, MT room)

12:40-13:50 Lunch meeting with young researchers and students

Assist. Profs.: Takumi YAMAZAKI, Tomoya KAWAGUCHI, Minha PARK

Specially Appointed Assist. Prof.: Rico POHLE

Ph.D. Students: Chisa ITO, Yuta KIMOTO, Hiroki YOSHISAKO

28th Nov. Thu.

(Honda Memorial Building, 3F, MT room)

12:40-13:40

Lunch meeting

External Evaluation Committee members

29th Nov. Fri.

(Honda Memorial Building, 3F, MT room)

9:00 Overall performance of IMR, Q and A (Director, total is one and half hours)

10:30 Break (30 min.)

11:00 Overall of GIMRT program (Prof. NOJIRI) Each 15min. (10 min. presentation and 5 min. Q & A)

11:15 International Research Center for Nuclear Materials Science (Prof. AOKI)

11:30 Cooperative Research and Development Center for Advanced Materials (Prof. KATO)

11:45 High Field Laboratory for Superconducting Materials (Prof. AWAJI)

12:00 Center for Computational Materials Science (Prof. KUBO)

12:15 Quantum Beam Center for Materials Research (Prof. UMETSU)

12:30 Lunch

13:00 Visit to Honda Memorial Room (Director, Deputy directors)

13:30 Evaluation committee meeting

16:30 Close

Summit of Materials Science 2024 and GIMRT User Meeting 2024

Date: November 27-28, 2024
Venue: IMR Auditorium, Tohoku University (Onsite)

Day 1: Nov. 27

Opening					
	10:00	10:05	Rie Umetsu	IMR	Opening
	10:05	10:20	Takahiko Sasaki	IMR	Welcome Address

Number	Time		Name	Affiliation	Title
Session A Strong Correlation and Topology (Chair: Yusuke Nomura, IMR)					
A-1	10:20	10:50	Roser Maria Valentí	Goethe University Frankfurt	Strategies to Design Quantum Materials with Exotic Properties
A-2	10:50	11:20	Yoshinori Onose	IMR	Chirality Control and Detection in Metallic Helimagnets
A-3	11:20	11:35	Yoshihiro Okamura	The University of Tokyo	Magneto-Optical Study on Topological Magnets
A-4	11:35	11:50	Takuya Aoyama	Hiroshima University	Piezomagnetism in Antiferromagnets with Broken Time-Reversal Symmetry
A-5	11:50	12:20	Masaki Fujita	IMR	Neutron Scattering Study on Spin Excitations Coupled with Charge and Lattice Dynamics
	12:20	13:50	Lunch Break (Photo Session @1st Building Lobby)		
Session B Energy Materials (Chair: Hidemi Kato, IMR)					
B-1	13:50	14:20	Tetsuya Uda	Kyoto University	Lithium-Ion Battery Recycling through Comminution in Water in Inert Atmosphere
B-2	14:20	14:50	Andreas Züttel	EPFL	Power Plant Units for CO_2 Neutral Energy Security
B-3	14:50	15:20	Tetsu Ichitsubo	IMR	Development of Metal-Anode Battery and Dual Ion Battery Systems with Multivalent Cation
B-4	15:20	15:50	Kozo Fujiwara	IMR	Fundamental and Applied Research on Crystal Growth
	15:50	16:00	Break		
Session C Computational Materials Science and Informatics (Chair: Momoji Kubo, IMR)					
C-1	16:00	16:30	Maria Clelia Righi	University of Bologna	Advancing Solid Interface and Lubricants by First Principles
C-2	16:30	17:00	Emi Minamitani	Osaka University	Elucidating Structure-Property Correlation in Amorphous Materials by Persistent Homology
C-3	17:00	17:30	Yu Kumagai	IMR	Defects in Semiconductors: A First-Principles Investigation
C-4	17:30	17:45	Kazushi Fujimoto	Kansai University	Mechanical Response Mechanisms during Compression Fracture of Polymer Particles
	17:45	19:00	Poster Session @2nd Building Lobby		
	19:00	20:30	Mixer @Lounge		

Day 2: Nov. 28

Number	Time		Name	Affiliation	Title
Session D Structural Materials (Chair: Kenta Yamanaka, IMR)					
D-1	9:30	10:00	Young-Kook Lee	Yonsei University	Hydrogen Embrittlement of High-Strength Martensitic Steel
D-2	10:00	10:30	Tadashi Furuhara	IMR	Alloying Effects on Microstructure Development in High Strength Steels – from Bulk to Surface
D-3	10:30	11:00	Martin Luckabauer	University of Twente	Tailoring Omega Transformation Kinetics in Beta Titanium Alloys for Biomedical Applications
	11:00	11:10	Break		
Session E Nuclear Materials (Chair: Dai Aoki, IMR)					
E-1	11:10	11:40	Jean-Pascal Brison	CEA-Grenoble	Field and Pressure Tuning of the Superconducting Pairing Mechanisms in UTe_2
E-2	11:40	12:10	Ryuta Kasada	IMR	Redesigning, Restructuring and Reviving Nuclear Materials Research in Japan towards a New Concept of Irradiation 3.0
E-3	12:10	12:25	Hiroyuki Kazama	Osaka University	Gas-Phase Oxidation of Actinide Ions in Triple Quadrupole Inductively Coupled Plasma Mass Spectrometry
E-4	12:25	12:40	Sayuri Takatori	Okayama University	Spectroscopy of Thorium-229 Nuclear Clock Transition in $^{229}Th:CaF_2$ Crystal
	12:40	13:40	Lunch Break		
Session F Frontier in Metal and New Materials (Chair: Eiji Akiyama, IMR)					
F-1	13:40	14:10	Eun Soo Park	Seoul National University	High Entropy Alloy Foam: Open a New Era of Thermal Protection Utilizing Metals
F-2	14:10	14:40	Hidemi Kato	IMR	Dissimilar Joining of Immiscible Metals by Eutectic Melting Induced Liquid Metal Dealloying
F-3	14:40	15:10	Hitoshi Miyasaka	IMR	Chemo-Switchable MOF Magnets
	15:10	15:20	Break		
Session G Functional Magnetic, Electronic and Semiconducting Materials (Chair: Yoshinori Onose, IMR)					
G-1	15:20	15:50	Kiyonori Suzuki	Monash University	Ultra-Low Core Loss of Nanocrystalline Soft Magnetic Alloys Brought about by Near-Zero Magnetostriction
G-2	15:50	16:20	Takeshi Seki	IMR	Control of Magneto-Elasticity in Magnetic Thin Films
G-3	16:20	16:35	Takamasa Hirai	NIMS	Elastocaloric Kirigami Temperature Modulator
G-4	16:35	16:50	Yoshitaro Nose	Kyoto University	Processing for Group IV Chalcogenides with 2D Structure Based on Thermodynamics
	16:50	17:00	**Closing**		

Poster Session

Number	Name	Affiliation	Title
PS01	Mayurkumar Ashwinbhai Makhesana	Nirma University	Synthesis and Characterization of Metallic Nanoparticles via Laser Ablation Synthesis in Solution and Aerosol Jet Printing
PS02	Anna Kosogor	Institute of Magnetism NASU and MESU	Magnetic Properties, Phase Diagram and Low-Temperature Specific Heat of $Ni_{50}Mn_{50-x}Sb_x$ Alloys
PS03	Yoichi Ikeda	IMR	Current Status of a Triple-Axis Neutron Spectrometer 6G-TOPAN
PS04	Shigeru Okada	Kanagawa University	Syntheses and Properties of Single-Phase RuB_2 Material by Arc Melt Method
PS05	Yulin Xie	IMR	High-Throughput Investigation of Cr-N Cluster Formation in Fe-35Ni-Cr System during Low-Temperature Nitriding
PS06	Taiki Miura	IMR	Effect of Ligament Crystal Ordering on Porous Structure Formation and Coarsening in Liquid Metal Dealloying
PS07	Toyoto Sato	IMR	Hydrogen Absorption Reactions and Crystal Structure of $(Y, Mg)Co_3$
PS08	Kenji Yoshino	University of Miyazaki	Development of Low-Temperature Non-Vacuum Growth of ZnO Protective Film for Mg-Ion Battery
PS09	Kaoru Kouzu	Kokushikan University	Syntheses and Its Properties of $R(Al,Mo)B_4$ (R=Rare Earth) Compounds by High-Temperature Al Melt Method
PS10	Takeshi Hagiwara	Kanagawa University	Synthesis of $AlMgB_{14}$ Crystal Using Magnesium Fluoride by Al-Self Flux and Its Physicochemical Properties
PS11	Hong-Fei Zhao	IMR	Search for Short-Range Ordering in Medium-Entropy Alloys (Mn-Co-Ni and Cr-Co-Ni) via Neutron Scattering
PS12	Zaskia Alifia	University of Toyama	Nanoparticle Synthesis of $BiVO_4$/Ag for Enhanced Dye Photodegradation Illuminated by Visible Light
PS13	Hiroya Ishii	IMR	Effects of Composition and Processing on the Microstructures, Mechanical Properties and Corrosion Behavior of Biodegradable Fe-Mn Alloys
PS14	Takumi Yamazaki	IMR	Figure of Merit of Transverse Thermoelectric Conversion for Magnetic Thin Film Measured by All-in-One Evaluation Method
PS15	Hidetoshi Masuda	IMR	Nonreciprocal Electronic Transport Induced by Current-Induced Deformation of Helimagnetic Structure in YMn_6Sn_6
PS16	Hsiao-Yi Chen	IMR	Development of an Ab Initio Method for Non-Coplanar Chiral Magnets and Response Properties
PS17	Rico Pohle	IMR	Spin Nematics Meet Spin Liquids: Exotic Phases in the Spin-1 Bilinear-Biquadratic Model with Kitaev Interactions
PS18	Yoichi Nii	IMR	Gigahertz Topological Surface Acoustic Wave on a Nano-Scaled Honeycomb Phononic Crystal
PS19	Hiroshi Kakinuma	IMR	Microscopic Imaging of Hydrogen Diffusion in Metals Using Polyaniline
PS20	Junyi Luo	IMR	Anisotropy of Critical Current Density Properties of the High-Performance SS/Ag-Sheathed $Ba_{1-x}K_xFe_2As_2$ Tapes
PS21	Chanhyeon Lee	IMR	Emergent $\sqrt{3} \times \sqrt{3}$ Type Gapless Quantum Spin Liquid in Spin – 1/2 Random Kagome Antiferromagnet $YCu_3(OD)_{6.5}Br_{2.5}$
PS22	Yuji Seki	Keio University	Theoretical Calculation of Transport Coefficients in Infinite-Layer Nickelates
PS23	Koji Inoue	IMR	Effects of P on Formation and Growth of Mn-Ni-Si Clusters in Low-Cu Reactor Pressure Vessel Steel
PS24	Haruka Yoshino	IMR	Ultrafast Luminescence Sensing with Selective Adsorption of Carbon Disulfide in an Au(I) Metal-Organic Framework

Number	Name	Affiliation	Title
PS25	Satoshi Iguchi	IMR	Magneto-Optical Detection of Altermagnetism in Organic Antiferromagnet
PS26	Oleksandr Prokhnenko	Helmholtz-Zentrum Berlin	Magnetic Order and Spin Dynamics in Natural Mineral Brochantite $Cu_4SO_4(OH)_6$
PS27	Qingxin Liu	IMR	Dynamical Spin Reordering in a Hybrid Layered Ferrimagnet with Biferrocenium Radicals
PS28	Ke Ji	IMR	Intra-Lattice Hydrogen Bonds-Related Charge Manipulations Associated with Guest Removal in Charge Transferred Layered Metal-Organic Frameworks
PS29	Tetsuya Furukawa	IMR	Thermoelectric Properties of an Ambient-Pressure Organic Dirac Electron System α-$(BETS)_2I_3$
PS30	Ali Md. Arafat	Tohoku University	High-Resolution Spatial Mapping of π-Radical Spin States in Single-Molecule Magnets with Electron Spin Resonance
PS31	Tsutomu Nojima	IMR	Research on Polar Superconductivity in Ion-Gated $SrTiO_3$
PS32	Yixin Su	IMR	Reactive Molecular Dynamics Simulations Revealing the Impact of Carbon Nanotube (CNT) Volume Fraction on the Mechanical Properties of SiC/CNT Composites
PS33	Muhammad Khalish Nuryadin	IMR	Disorder Effect Induced by *X*-ray Irradiation on a Monomer Mott Insulator (BEDT-TTF)$Cu[N(CN)_2]_2$
PS34	Shiori Sugiura	IMR	Disorder Effect to the High-Field FFLO Phase in Layered Organic Superconductor κ-$(BEDT\text{-}TTF)_2Cu(NCS)_2$
PS35	Yuta Kimoto	IMR	Observation of Spin Motive Force and Conduction Noise in a Sliding Helimagnetic Structure
PS36	Ryo Kawakami	University of Tsukuba	Synthesis and Characterization of Polyaniline Type Metal-Doped Magnetic Conjugated Polymers

Appendix 4 IMR Organization Chart (Nov. 2024)

- Director
  Prof. T.SASAKI
  - Deputy Director
    Prof. R.UMETSU
  - Deputy Director
    Prof. H.MIYASAKA
- Research Laboratories
  - Materials Property Division
    - Theory of Solid State Physics (Prof. Y. NOMURA)
    - Crystal Physics (Prof. K. FUJIWARA)
    - Magnetism (Prof. H. NOJIRI)
    - Surface and Interface
    - Low Temperature Physics
    - Low Temperature Condensed State Physics (Prof. T. SASAKI)
    - Quantum Beam Materials Physics (Prof. M. FUJITA)
  - Materials Design Division
    - Quantum Functional Materials Physics (Prof. Y. ONOSE)
    - Microstructure Design of Structural Metallic Materials (Prof. G. MIYAMOTO)
    - Materials Design by Computer Simulation (Prof. M. KUBO)
    - Irradiation Effects in Nuclear and Their Related Materials (Prof. Y. NAGAI)
    - Environmentally Robust Materials (Prof. E. AKIYAMA)
    - Nuclear Materials Engineering (Prof. R. KASADA)
    - Advanced Crystal Engineering (Prof. A. YOSHIKAWA)
  - Materials Development Division
    - Chemical Physics of Non-Crystalline Materials (Prof. K. SUGIYAMA)
    - Structure-Controlled Functional Materials (Prof. T. ICHITSUBO)
    - Solid-State Metal-Complex Chemistry (Prof. H. MIYASAKA)
    - Non-Equilibrium Materials (Prof. H. KATO)
    - Magnetic Materials (Prof. T. SEKI)
    - Crystal Chemistry (Prof. T. SASAKI)
    - Hydrogen Functional Materials (Prof. S. ORIMO)
  - Materials Processing and Characterization Division
    - Multi-Functional Materials Science (Prof. Y. KUMAGAI)
    - Deformation Processing (Assoc. Prof. K. YAMANAKA)
    - Actinide Materials Science (Prof. D. AOKI)
    - Materials Science of Non-Stoichiometric Compounds
    - Analytical Science
  - Integrated Research Division
    - Exploratory Research Laboratory (Prof. H. MIYASAKA)
  - Collaborative Research Division
  - Project
    - Design & Engineering by Joint Inverse Innovation for Materials Architecture (Prof. H. KATO)
- Research Facilities
  - International Research Center for Nuclear Materials Science (Head/ Prof. D. AOKI)
    - Laboratory of Alpha-Ray Emitters
  - Cooperative Research and Development Center for Advanced Materials (Head/Prof. H. KATO)
  - High Field Laboratory for Superconducting Materials (Head/Prof. S. AWAJI)
  - Collaborative Research Center on Energy Materials (Head/ Prof. T. ICHITSUBO)
- Collaboration Research Centers
  - Center for Computational Materials Science (Head/Prof. M. KUBO)
  - Quantum Beam Center for Materials Research (Head/Prof. R. UMETSU)
  - International Collaboration Center (Head/Prof. H. NOJIRI)
- Laboratory of Low Temperature Materials Science (Prof. T. SASAKI)
- Analytical Research Core for Advanced Materials (Prof. E. AKIYAMA)
- Counseling Office for Student, Faculty and Staff (Prof. R UMETSU)
- Technical Service Center (Head: T. SUGAWARA)
- Office for Innovative Knowledge Hub in Humanities and Materials Science （Prof. M. FUJITA）
- Administrative Office (Head: M. FUNADA)

Research laboratory (5 divisions, 27 laboratories)

Materials Property Division (7 laboratories)

Theory of Solid State Physics [Prof. Y. Nomura]

Crystal Physics [Prof. K. Fujiwara]

Magnetism [Prof. H. Nojiri]

Surface and Interface

Low Temperature Physics

Low Temperature Condensed State Physics [Prof. T. Sasaki]

Quantum Beam Materials Physics [Prof. M. Fujita]

Materials Design Division (7 laboratories)

Quantum Functional Materials Physics [Prof. Y. Onose]

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Actinide Materials Science [Prof. D. Aoki]
Materials Science of Non-Stoichiometric Compounds
Analytical Science

Integrated Research Division (1 laboratory)
Exploratory Research Laboratory [Prof. H. Miyasaka]

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High Field Laboratory for Superconducting Materials [Head/Prof. S. Awaji]
Collaborative Research Center on Energy Materials [Head/Prof. T. Ichitsubo]

Collaboration Research Centers

Center for Computational Materials Science [Head/Prof. M. Kubo]
Quantum Beam Center for Materials Research [Head/Prof. R. Umetsu]
International Collaboration Center [Head/Prof. H. Nojiri]