Collaborative Research Projects – 2025
Joint Usage/Research Center Research Center for Advanced Inorganic Materials
Materials and Structures Laboratory, Institute of Integrated Research,
Institute of Science Tokyo

Outline and Application Instructions

1. Outline of the Projects

The Collaborative Research Projects (hereafter, "CRP") of the Materials and Structures Laboratory (hereafter, "MSL"), Institute of Integrated Research, Institute of Science Tokyo, include the following five different types of research and workshop to be carried out at MSL/ organized by MSL in collaboration with MSL faculties including Assistant, Associate, and Full Professors (hereafter, "MSL Faculties").

International CRP (of Category A or B):

Research project conducted by a team consisting of MSL faculties and researchers of foreign organizations using the facilities, equipment, data, etc., available at MSL.

General CRP (of Category A, B or C):

Research project conducted by a team consisting of MSL faculties and researchers of other organizations, using the facilities, equipment, data, etc., available at MSL.

Topic-Specified CRP:

Research projects on one of the following topics coordinated by MSL faculties and conducted by a team consisting of MSL faculties and researchers of other organization, using the facilities, equipment, data, etc., available at MSL.

Specified Research Topics (Please see the abstracts of the topics on page 4.)

1. Yolk@Shell Nanostructures as Superior Plasmonic Photocatalysts for Solar Hydrogen Production across Visible to Near Infrared Spectral Region
2. Development of active and uniform complex metal oxide catalysts
3. Seismic performance evaluation of nonstructural components based on response characteristics of buildings
4. Development of materials digital transformation approach and new electronic functional materials and devices

International Workshop:

Small-scale international discussion meeting on a focused topic to promote MSL CRP, organized by MSL.

Workshop:

Small-scale discussion meeting on a focused topic to promote MSL CRP, organized by MSL.

* **Award for Outstanding Researchers**

The MSL Award for Research will be presented to the outstanding researchers.

* **Financial Support for Conferencing**

MSL provides financial support for conferencing.

2. Qualified Applicants

Researcher with a doctoral or an equivalent who reasonably approves the agreements on intellectual property rights with MSL. (Please see Appendix 1. the Regulation on Intellectual Property Right yielded from MSL CRP on page 9.)

(Technical staff and postgraduate students may be a collaborator for CRP.)

Project representative may apply once for International or General CRP, and once for International Workshop or Workshop, at most.

3. How to apply

Prior to application, applicant should consult with MSL faculties regarding research subject, period, and expenses, etc.

General information of MSL including organizations, faculty members, and research abstracts, can be obtained in MSL website (https://www.msl.titech.ac.jp/english.html).

International CRP, General CRP and Topic-Specified CRP:

Applicant should submit application forms (use Form 1 and Form1_(description) attached) to the office for MSL CRP by e-mail (suishin@msl.titech.ac.jp). The application form can be downloaded from MSL website (https://www.msl.titech.ac.jp/english/msl_crp_en/crp__en/application_forms 2025.html).

International Workshop and Workshop:

Applicant should submit application forms (use Form 2 and Form2_(description) attached) to the office for MSL CRP by e-mail (suishin@msl.titech.ac.jp). The application form can be downloaded from MSL website (https://www.msl.titech.ac.jp/english/msl_crp_en/crp_2025_en/application_forms 2025.html).

4. Period of Project

International CRP and General CRP:

About one year from April 10th 2025 to March 20th 2026. Research period may be extended up to a maximum of three years, provided that project representative of project should apply newly in each year.

International Workshop and Workshop:

Between April 10th 2025 to March 20th 2026

5. Research Expenses

Necessary expenses for the CRP or Workshop may be covered in accordance to the budget allocated.
（The airfare and public transportation fare are covered.）

6. Deadline of Application

January 6th, 2025 (No application will be accepted later than the deadline.)

7. Selection and Notification

The decision shall be notified to each applicant (i.e. project representative) early in April, 2025.

8. Report of CRP / Workshop

After the completion of CRP or Workshop, representative of CRP or Workshop is required to submit "Report on CRP" or "Report on Workshop" to the office for CRP by e-mail (suishin@msl.titech.ac.jp).

The report should include a power point slide describing the results of CRP or Workshop.

9. Publication of Research Results and Others

In case of publishing the results of MSL CRP, please acknowledge the sponsorship for the collaborative research project provided by the Materials and Structures Laboratory.

Please use the following name(s), if necessary, in your acknowledgment.

1. **Materials and Structures Laboratory, Institute of Integrated Research, Institute of Science Tokyo**

2. **Collaborative Research Project of Materials and Structures Laboratory, Institute of Integrated Research, Institute of Science Tokyo**

Please note that the intellectual property rights yielded from MSL CRP are under the regulation of MSL, as stated in Appendix 1. For details of the regulation, please contact the office for MSL CRP.

10. Accommodation

Accommodations in Tokyo Institute of Technology are not available.

11. Where to submit and contact

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Abstracts of Topic-Specified Collaborative Research Projects

Yolk@Shell Nanostructures as Superior Plasmonic Photocatalysts for Solar Hydrogen Production across Visible to Near Infrared Spectral Region

Representative: Chun-Yi Chen

Near infrared energy remains untapped toward the maneuvering of entire solar spectrum harvesting for fulfilling the nuts and bolts of solar hydrogen production. We report the use yolk@shell nanocrystals as dual plasmonic photocatalysts to achieve remarkable hydrogen production under visible and near infrared illumination. Ultrafast spectroscopic data reveal the prevalence of long-lived charge separation states for Au@Cu7S4 under both visible and near infrared excitation. Combined with the advantageous features of yolk@shell nanostructures, it is possible to achieves a peak a record-breaking quantum yield for hydrogen production in the absence of additional co-catalysts. The design of a sustainable visible- and near infrared-responsive photocatalytic system is expected to inspire further widespread applications in solar fuel generation. In this work, the feasibility of exploiting the localized surface plasmon resonance property of self-doped, nonstoichiometric semiconductor nanocrystals for the realization of wide-spectrum-driven photocatalysis is highlighted. The current study not only delivers a new type of plasmonic photocatalyst paradigms enabling efficient H2 production from the untapped near infrared energy, but also illustrates the utility of the novel yolk@shell nanostructures in plasmonic photocatalysis. The finding of this work offers a promising strategy to the expansion of the photo response range for the currently available photocatalysts in order to realize full-spectrum driven solar H2 production.

Development of active and uniform complex metal oxide catalysts

Representative: Satoshi Ishikawa

Solid catalysts are utilized in various fields such as efficient resource conversion and energy production. However, their functions are not fully understood. This is because, to achieve high catalytic performance, the catalyst state becomes highly complex in terms of its structure and components, making it extremely difficult to identify the catalytic active sites. In this study, we aim to develop highly active complex metal oxide catalysts with a uniform manner. Unlike conventional catalysts, these catalysts have a uniform composition and structure, allowing us to investigate the relationship between their crystal structure and catalytic function to clarify the catalytically active structures. By integrating inorganic synthetic chemistry, catalysis science, and analytical chemistry at a high level, we elucidate the catalytic functions of highly active catalysts.

Seismic performance evaluation of nonstructural components based on response characteristics of buildings

Representative: Tadashi Ishihara

The demand for the continuous use of buildings after earthquakes has been increasing year by year. Now that a certain level of earthquake resistance of the structural frame has been secured, it is important to control seismic damage to nonstructural components (NSCs). In the seismic design of NSCs, the response characteristics of various buildings are not always fully taken into account. Seismic resistance of NSCs is often confirmed using design seismic forces and target deformations, which may result in insufficient design targets. This study examines the seismic response and behavior of NSCs considering the response characteristics of buildings and evaluates their seismic performance.

Development of materials digital transformation approach and new electronic functional materials and devices

Representative: Toshio Kamiya

Combining data analysis as well as materials simulations and experimental materials research has become important to accelerate the development of new materials and devices. Thus, it is an urgent issue to build a new materials digital transformation system (MDX). In this project, we welcome ideas of a part of such MDX approach, its total design, or related issues.

MSL faculty members

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(Excerpt) Equipment Available for Collaborative Research at the Laboratory for Materials and Structures [MSL faculty members to contact]

Equipment	Contact person
High-pressure synthesis appraratus SQUID Magnetometer (MPMS; Quantum Design) Physical Property Measurement System Under High Magnetic Field Atomic Force Microscopy System X-RAY DIFFRACTOMETER Walker-type high pressure apparatus	AZUMA Masaki SHIGEMATSU Kei
High performance liquid chromatography Electron Spectroscopy for Chemical Analysis Infrared Spectrometer CHN elemental analyzer Glovebox System Fourier Transform Infrared Spectroscopy	HARA Michikazu ISHIKAWA Satoshi HATTORI Masashi

Equipment	Contact person
Experimental Equipment for Non-Structural Components	ISHIHARA Tadashi
Capillary gas chromatography Fourier Transform Infrared Spectrometer UV-Vis Absorption Spectrometer	KAMATA Keigo AIHARA Takeshi
SQUID Magnetometer (MPMS; Quantum Design) High-Resolution Solid-State NMR Spectrometer (BRUKER AVANCE III HD) Single-Crystal Four-Circle Diffractometer X-ray Powder Diffractometer ^{3}He-^{4}He Dilution Refrigerator Heat capacity measurement system using relaxation method	KAWAJI Hitoshi KITANI Suguru
2000kN Dynamic Loading Actuator 200tf Universal Testing Machine 500kN Temperature Variable High Rigidness Material Testing Machine Multi-Dimensional Long Stroke Loading System Reaction Frame (1000kN and 500kN Oil Jacks) Load & Displacement Control System for Structural Experiments 1000kN hydraulic jack with 2 directional load cells 200kN hydraulic jacks	KISHIKI Shoichi KUROSAWA Miku
DATA LOGGER TDS630, Tokyo Sokki Kenkyujo Servo controlled static hydraulic pump and controlling units 4MN hydraulic jacks Concrete cylinder specimen end grinding machine	KONO Susumu
“Scanning Electron Microscope” Hitachi Regulus8230	MAJIMA Yutaka
Equipment for single crystals growth Equipment for physical properties evaluation under extreme conditions Maskless Electronic Device Fabrication System	SASAGAWA Takao

Maximum budget for individual grants

Type of CRP	Category	Maximum Allocation	
		Travel	Materials and Supplies
International CRP	*A	¥ 1,000,000	¥ 400,000
	B	¥310,000	¥ 40,000
General CRP	*A	¥ 650,000	¥ 400,000
	B	¥140,000	¥ 100,000
	C	¥ 30,000	¥ 100,000
International Workshop, Workshop		¥ 600,000	¥ 120,000

* Project representative may apply once for International or General CRP, and once for International Workshop or Workshop, at most.

Appendix 1: Regulation on Intellectual Property Right Yielded from MSL CRP

· Case of researchers who belong to universities

In general, the yielded right shall belong to the researcher or his/her institute/university. In case when the contributions from researchers of Institute of Science Tokyo to the invention you are to file as an intellectual property are recognized to be significant, Science Tokyo shall discuss with you the property right.

When you file patents and/or intellectual property rights yielded from MSL CRP, you shall provide us at the office for MSL CRP with a copy of the filing/filed documents. (The office for MSL CRP shall strictly storage the copy and keep the secrecy of your filing.)

· Case of those other than afore-defined

In general, the yielded right shall belong to the researcher (of this category) or his/her institute/company. In case when the contributions from researchers of Science Tokyo to the invention you are to file as an intellectual property are recognized to be significant, Science Tokyo shall discuss with you the property right.

When you file patents and/or intellectual property rights yielded from MSL CRP, you shall provide us at the office for MSL CRP with a copy of the filing/filed documents. Moreover, in case when profits from the utilization of the filing/filed intellectual properties are anticipated, Science Tokyo shall discuss with the right holder the consideration of the utilized facility at Science Tokyo. (The office for MSL CRP shall strictly storage the copy and keep the secrecy of your filing.)