Academic Year 2027

Graduate School of Engineering, The University of Tokyo

Department of Applied Chemistry

Guide to Entrance Examinations

Master's Program

Doctoral Program

【Contact】

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Objectives of Education/Research at the Department of Applied Chemistry

The objectives of education and research in our department are to cultivate independent human resources who have both a wide-ranging foundation and advanced expertise in applied chemistry and can take the initiative in conducting research and development in a variety of fields based on them. In addition, our department also aims to promote world-leading cutting-edge research.

General Information for Applicants in AY 2027

It is possible that the contents of the Application Guidelines for the Graduate School of Engineering and the Guide to Entrance Examinations for the Department of Applied Chemistry will be changed. In that case, we will announce the change on the following websites, so you need to check them at any time.

Graduate School of Engineering Website:
https://www.t.u-tokyo.ac.jp/en/soe/admission/general-guideline
Department of Applied Chemistry Website:
https://www.t.u-tokyo.ac.jp/en/study-at-utokyo/soe/apply/guideline

1. Periods of Acceptance of Application and Examinations (Refer to the Application Guidelines for the Graduate School of Engineering)

Regular Admission

Master's Program (for those who wish to enroll in April or October)[*1]

Application accepted	From May 29 to June 4 (3 pm), 2026
Examination dates[*1, *2]	From August 31 to September 1, 2026[*2]
Announcement of successful applicants	September 10, 2026

Doctoral Program[*1]

		Application Schedule A		Application Schedule B
		For those who wish to enroll in April	For those who wish to enroll in October	
Application accepted		From May 29 to June 4 (3 pm), 2026		From November 27 to December 3 (3 pm), 2026
Examination dates	First stage[*1]	September 1, 2026[*2]		Mid-January to early February, 2027[*3]
	Second stage	Late January to early February, 2027[*3, *4]	At the same time as the first stage	At the same time as the first stage
Announcement of successful applicants		(September 10, 2026 for the first stage result) February 12, 2027	September 10, 2026	February 12, 2027

*1 For information on eligibility and application procedures, see Application Guidelines for the Graduate School of Engineering.

*2 Refer to the examination dates specified in this Guide (p. 8). It is possible that the examination dates will be changed. Therefore, you need to check the websites of Graduate School of Engineering and Department of Applied Chemistry at any time.

*3 The date will be announced later.

*4 For those who have been conferred, or are expected to be conferred by September 30, 2026, a Master's or a professional degree, details will be notified separately.

2. Implementation Methods, etc.

1) In principle, the examination will be held on-site. Details regarding the venue and other matters will be announced separately.
2) Applicants must enter the designated examination room at least 20 minutes before the start of the examination.

3. Items to Bring

1) Examination admission card
2) Black pencils (or black mechanical pencils), an eraser, a pencil sharpener (a desktop type is not allowed), and a watch (watches with functions other than time measurement are not allowed).
3) Use of electronic devices such as cell phones is strictly prohibited throughout the examination, even if you only use it as a watch. Make sure to completely deactivate any sound alerts and/or alarm settings, turn off the phone's power, and put it in your bag before you enter the examination room. Do not take it out in the examination room.

4. Notice during the Written Examinations

1) Follow the instruction from the proctor during the examination.
2) You cannot leave the examination room after the start of the examination.
3) The examination admission card must be kept on your desk at all times during the examination.
4) Applicants cannot take home the answer sheets or the problem booklets after the examination.
5) Do not leave the room until instructed to do so by the proctor.

5. Others

1) If there is a change in your current address or contact information after submitting the application, you must notify us of it promptly.
2) We do not answer any inquiries about acceptance or rejection by telephone calls, fax, e-mail, and other inquiries.
3) If any false statement or forgery is found in the application documents, or if there is clear evidence that there was any fraudulent activity in the examination, the pass may be canceled even after enrolling in or going on to a graduate school.

Information of Examinations for the Applicants for the Department of Applied Chemistry (Master's Program), Graduate School of Engineering, The University of Tokyo

1. Any applications who meet the qualifications for a master's program will be accepted, irrespective of the department they graduated from and the year when they were qualified.
2. Applicants are required to fill out the **Questionnaire Sheet 1** (p. 10, p. 11) in this Guide and specify the order of preference on the **Questionnaire Sheet 2** (p. 12). Submit both questionnaires together with the application for admission.
3. Note that those who do not fulfill the required number of subjects will be rejected. In order to qualify for admission, it is necessary to meet both requirements: "the evaluation by the total score of 1) foreign language, 2) general education subjects, and 3) oral examination" and "the evaluation by 3) oral examination alone".
4. Priority to be assigned to the first-choice laboratory will be given to a small number of applicants who wish to proceed to a doctoral program at the same laboratory where they will complete their master's program. Applicants wishing to go on to a doctoral program at their first-choice laboratory should apply through the Department of Applied Chemistry website (https://www.appchem.t.u-tokyo.ac.jp/examination/) by July 31, 2026, and contact the faculty member of the laboratory of their choice.
5. Foreign nationals who have the qualifications listed in the Application Guidelines for the Graduate School of Engineering are eligible to take Special Selection for International Applicants. Applicants who wish to take the Special Selection for International Applicants must contact the faculty member of the desired laboratory by May 12, 2026, and have an interview and guidance before applying. Applicants who have graduated or are expected to graduate from The University of Tokyo or other universities in Japan must take the regular admission examination.
6. If any false statement or forgery is found in the application documents, or if there is clear evidence that there was any fraudulent activity in the examination, the pass may be canceled even after enrolling in or going on to a graduate school.
7. Assignments of successful applicants to laboratories will be posted on the bulletin board of the Department of Applied Chemistry at Building No. 5 of the Faculty of Engineering and the Department of Applied Chemistry website after the announcement of successful applicants.

Examination subjects	Remarks
1) Foreign language (English) *1 Submission of an official score: TOEFL iBT or TOEFL-iBT Home Edition	There will be no written test at the venue. (200 points)
2) General education subjects Chemistry Physical Chemistry (1 problem) Inorganic Chemistry (1 problem) Organic Chemistry (1 problem)	Answer two of the three problems in physical chemistry, inorganic chemistry, and organic chemistry. Problems related to analytical chemistry, polymer chemistry, and biochemistry may be included. (600 points)
3) Oral examination	In the oral examination, motivation for studying at the Department of Applied Chemistry and communication ability are gauged. In addition, questions on research for the graduation thesis (or the equivalent) and general chemistry are asked. (100 points)

*1【**Notes**】

- Applicants should submit a score from a test administered in September 2024 or later.
- Score submission deadline: August 10, 2026
- For information on how to submit a score, please refer carefully to the information provided in Application Guidelines for the Graduate School of Engineering.

Information on Examinations for the Applicants for the Department of Applied Chemistry (Doctoral Program), Graduate School of Engineering, The University of Tokyo

I. The First-stage Examination

1. Any application who meet the qualifications for a doctoral program will be accepted, irrespective of the field of specialization in the master's program and the year when they were qualified.
2. Applicants are required to contact the academic supervisor whom they want to be guided by in the program. After receiving guidance and an interview, applicants must obtain the consent of the supervisor before applying.
3. All applicants, except those who have completed (or are expected to complete) the Graduate School of Engineering of The University of Tokyo, must submit an Academic Transcript from the Previous University specified in "7. Documents to Submit" in the Application Guidelines for the Graduate School of Engineering.
4. Applicants are required to specify the name of academic advisor whom they want to be guided by in the **Questionnaire Sheet 1** (p. 10, p. 11) in this Guide and submit it together with the application for admission.
5. The examination subjects are as listed below. Note that those who do not fulfill the required number of subjects will be rejected. In order to qualify for admission, it is necessary to meet the requirements in all categories from 1) to 3).
6. If any false statement or forgery is found in the application documents, or if there is clear evidence that there was any fraudulent activity in the examination, the pass may be canceled even after enrolling in or going on to a graduate school.

Application Schedule A

Examination subjects *1	Remarks
1) Foreign languages (English) *2, *3, *4 Submission of an official score: TOEFL iBT or TOEFL-iBT Home Edition	There will be no written test at the venue.
2) Specialized academic subjects *5	Essay type examination on specialized academic subjects
3) Oral examination *5	Questions on the research performed in one's master's program or equivalent thereof are asked.

Application Schedule B

Examination subjects [*1]	Remarks
1) Foreign languages (English) [*2, *3, *4] Submission of an official score: TOEFL iBT or TOEFL-iBT Home Edition	There will be no written test at the venue.
2) Specialized academic subjects [*5]	Essay type examination on specialized academic subjects
3) Oral examination [*5]	Questions on the research conducted for one's master's program or its equivalent are asked.

Note:

*1 Applicants who have completed (or plan to complete) the master's or professional degree program at The University of Tokyo are exempted from "foreign languages".

*2 **Application Schedule A:** Applicants should submit a score from a test administered in September 2024 or later.
Application Schedule B: Applicants should submit a score from a test administered in February 2025 or later.
For information on how to submit a score, please refer carefully to the information provided in Application Guidelines for the Graduate School of Engineering carefully.

*3 **The score must be 61 in iBT or above**.

*4 Score submission deadline **Application Schedule A:** August 10, 2026
Application Schedule B: January 8, 2027

*5 For those who live outside Japan, remote examination using Zoom, for example, may be permitted.

II. The Second-stage Examination

Application Schedule A

For those who have passed the first-stage examination, questions on research in the master's program or the equivalent are asked.[*1, 2]

Note:

*1 For those who have been conferred, or are expected to be conferred by September 30, 2026, a Master's or a professional degree, details will be notified separately for applicants wishing to enroll in April. For applicants who wish to enroll in October, the examination will be held at the same time as the first-stage examination.

*2 For those who live outside Japan, remote examination using Zoom, for example, may be permitted.

Application Schedule B

An oral examination in the first-stage examination will also play the role of the second-stage examination. For those who live outside Japan, remote examination using Zoom, for example, may be permitted.

List of Laboratories

Number of students to be admitted in academic year 2026
Master's program: 33
Doctoral program: 13

Department	Name of Laboratory
Graduate School of Engineering	Noji Laboratory Yamaguchi Laboratory Yanagida Laboratory Nishibayashi Laboratory Uemura Laboratory Kim Laboratory Fujita Laboratory
Institute of Industrial Science	Tatsuma Laboratory Ishii Laboratory, Sunada Laboratory Tsukamoto Laboratory
Graduate School of Frontier Sciences	Takeya Laboratory (also serves as a lab in Graduate School of Engineering) Uchida Laboratory (also serves as a lab in Graduate School of Engineering) Suzuki Laboratory (also serves as a lab in Graduate School of Engineering)

Note for filling out the Questionnaire Sheet 2

- Assignment of successful applicants to laboratories is conducted in the order of scores of the examination, giving priority to the preference of the applicants with the highest grade. Enter the order of preference in the blank column on the left of each individual laboratory name. Note that you may not be able to pass if you cannot be assigned to any of the laboratory due to an incorrect entry (such as entering the same number in multiple spaces) or an entry in only some of the laboratories. If you wish to change the order of preference after submitting an application, fill out the **Questionnaire Sheet 2: Notification of Change** and submit it according to the instructions given during the general education subject examination.
- Applicants who wish to apply to a laboratory in the Graduate School of Frontier Sciences should contact the faculty member of the laboratory they wish to apply to in advance and receive guidance before applying.
- Priority to be assigned to the first-choice laboratory will be given to a small number of applicants who wish to proceed to a doctoral program at the same laboratory where they will complete their master's program. Applicants wishing to go on to a doctoral program at their first-choice laboratory should apply through the Department of Applied Chemistry website (https://www.appchem.t.u-tokyo.ac.jp/examination/) by July 31, 2026, and contact the faculty member of the laboratory of their choice.

Examination Dates

Program	Examination Subjects		Date and Time	Remarks
Master's Program	Foreign languages English			- Submit your official TOEFL® score. - There will be no written test at the venue.
	General education subjects Chemistry		September 1, 2026 From 9:00 to 11:00	- Answer two of the three problems in physical chemistry, inorganic chemistry, and organic chemistry. Important instructions regarding the notification of change will be given during this examination.
	Oral examination		August 31, 2026 From 9:00	- In the oral examination, motivation for studying at the Department of Applied Chemistry and communication ability are gauged. In addition, questions on research for the graduation thesis (or the equivalent) and general chemistry are asked.
Doctoral Program (Application Schedule A)	First-stage examination	Foreign languages English *1		- Submit your official TOEFL® score. - There will be no written test at the venue.
		Specialized academic subjects *2	September 1, 2026 From 13:00 to 14:30	
		Oral examination *2,*3	September 1, 2026 From 15:00	- Prepare two to three A4-sized sheets of your research summary in the master's program or the equivalent. - Make a presentation using Power Point or other software on a personal computer brought by the applicant (Twenty-minute presentation and ten-minute question and answer period).
	Second-stage examination *2,*4,*5		Late January to early February, 2027 *6	- For those who have passed the first-stage examination, questions on research conducted for one's master's program or its equivalent are asked.
Doctoral Program (Application Schedule B)	Foreign languages English *1			- Submit your official TOEFL® score. - There will be no written test at the venue.
	Specialized academic subjects *2		Mid-January to early February, 2027 *6	
	Oral examination *2,*5		Mid-January to early February, 2027 *6	- Same as Application Schedule A.

*1 Applicants who have completed (or plan to complete) the master's or professional degree program at The University of Tokyo are exempted from "foreign languages".

*2 For those who live outside Japan, remote examination using Zoom, for example, may be permitted.

*3 For those who are enrolled in the master's program of this department, this is substituted by the interim presentation of a master's thesis.

*4 For those who have been conferred, or are expected to be conferred by September 30, 2026, a Master's or a professional degree, details will be notified separately for applicants wishing to enroll in April. For applicants who wish to enroll in October, the examination will be held at the same time as the first-stage examination.

*5 For those who are enrolled in the master's program of this department, this is substituted by the final presentation of a master's thesis.

*6 The date and time will be announced later.

試験場案内(東京大学本郷キャンパス)
Campus Map for the Examination (Hongo campus, the University of Tokyo)

地下鉄利用　Subway

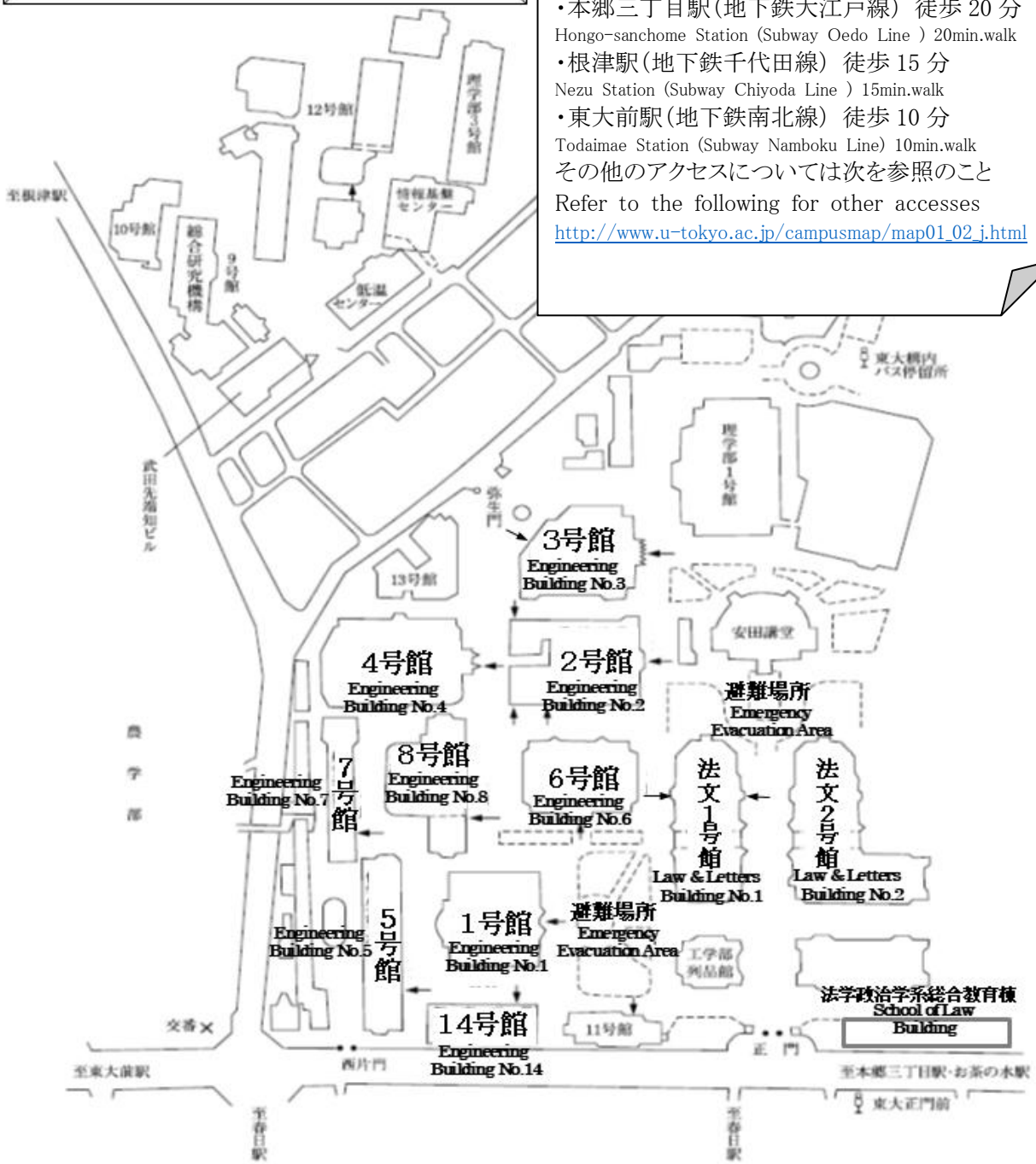
・本郷三丁目駅(地下鉄丸の内線) 徒歩 20 分
Hongo-sanchome Station (Subway Marunouchi Line) 20min.walk

・本郷三丁目駅(地下鉄大江戸線) 徒歩 20 分
Hongo-sanchome Station (Subway Oedo Line) 20min.walk

・根津駅(地下鉄千代田線) 徒歩 15 分
Nezu Station (Subway Chiyoda Line) 15min.walk

・東大前駅(地下鉄南北線) 徒歩 10 分
Todaimae Station (Subway Namboku Line) 10min.walk

その他のアクセスについては次を参照のこと
Refer to the following for other accesses
http://www.u-tokyo.ac.jp/campusmap/map01_02_j.html



【Applicants must submit this sheet together with the application for admission. Applicants for the master's program must also submit the **Questionnaire Sheet 2** on p. 12.】

Questionnaire Sheet 1

Department of Applied Chemistry
(For both master's and doctoral programs) Graduate School of Engineering, The University of Tokyo

Name of Applicant		＊ Examinee Number	
Former University (Department/Faculty)			
Contact information after examination: (Address, telephone number and email address of home, lodging, current university, etc.)	Telephone: Email address:		

Please describe in detail about (1) your motivation to enroll in or go on to the Department of Applied Chemistry, (2) what you want to study and research in the Department of Applied Chemistry, and (3) your future outlook and course plan.

【To master's program applicants】 The information contained herein will be used as a reference for the oral examination.

<Questionnaire Sheet 1 continued>

Name of an academic supervisor you want to be guided by **(for applicants to the doctoral program only)**	

* Do not enter the examinee number.

Questionnaire Sheet 2

(For applicants to the master's program only. Submit this sheet together with the application for admission.)

- Listed below are the names of all laboratories of the Department of Applied Chemistry.
- Enter the order of preference (1, 2, 3…) in the blank column on the left of each individual laboratory name.
- Note that you may not be able to pass if you cannot be assigned to any of the laboratory due to an incorrect entry (such as entering the same number in multiple spaces) or an entry in only some of the laboratories. It is highly recommended to keep a copy of this sheet.
- Priority to be assigned to the first-choice laboratory will be given to a small number of applicants who wish to proceed to a doctoral program at the same laboratory where they will complete their master's program. Applicants wishing to go on to a doctoral program at their first-choice laboratory should apply through the Department of Applied Chemistry website (https://www.appchem.t.u-tokyo.ac.jp/examination/) by July 31, 2026, and contact the faculty member of the laboratory of their choice.
- This form must be submitted at the time of application. If you wish to change the order of preference, fill out the **Questionnaire Sheet 2: Notification of Change** on the following page and submit it according to the instructions given during the general education subject examination.

Order of Preference	Name of Laboratory	Order of Preference	Name of Laboratory	Order of Preference	Name of Laboratory
	Noji Laboratory		Yamaguchi Laboratory		Yanagida Laboratory
	Nishibayashi Laboratory		Uemura Laboratory		Kim Laboratory
	Fujita Laboratory		Tatsuma Laboratory		Ishii Laboratory
	Sunada Laboratory		Tsukamoto Laboratory		Takeya Laboratory
	Uchida Laboratory		Suzuki Laboratory		

I declare that my order of preference is as above.

Name of Applicant

Questionnaire Sheet 2: Notification of Change

This form must be filled out only when the applicant for the master's program wishes to change the order of preference of laboratories and must be submitted according to the instructions given during the general education subject examination.

- Listed below are the names of all laboratories of the Department of Applied Chemistry.
- Enter the order of preference (1, 2, 3…) in the blank column on the left of each individual laboratory name.
- Note that you may not be able to pass if you cannot be assigned to any of the laboratory due to an incorrect entry (such as entering the same number in multiple spaces) or an entry in only some of the laboratories. It is highly recommended to keep a copy of this sheet.

Order of Preference	Name of Laboratory	Order of Preference	Name of Laboratory	Order of Preference	Name of Laboratory
	Noji Laboratory		Yamaguchi Laboratory		Yanagida Laboratory
	Nishibayashi Laboratory		Uemura Laboratory		Kim Laboratory
	Fujita Laboratory		Tatsuma Laboratory		Ishii Laboratory
	Sunada Laboratory		Tsukamoto Laboratory		Takeya Laboratory
	Uchida Laboratory		Suzuki Laboratory		

I declare that my order of preference is as above.

Name of Applicant
Examinee Number

Supervisors	NOJI LAB.
Hiroyuki NOJI, Professor Kazuhito TABATA, Associate Professor Hiroshi UENO, Lecturer	The main fields of our research are nanobioscience and nanobiotechnology; single-molecule biophysics, single-molecule digital bioassays, and artificial cell reactor project. ● Single-molecule biophysics We have been pursuing the elucidation of chemo-mechanical coupling mechanism of a rotary molecular motor, ATP synthase by use of single-molecule techniques. ● Single-molecule digital bioassay We developed femto-liter reactor technology that enables single-molecule enzymatic assays, termed 'digital bioassay'. This technology is currently utilized for single-molecule immunoassay digital ELSA that allows ultrasensitive and highly quantitative analysis. This novel analysis strategy attracts large attentions not only from academia but also from industry with expectation for the next-generation platform of diagnostic. ● Artificial cell reactor technology By implementing cell-free gene expression system into femto-reactors, we developed 'digital gene expression' system that allows analysis of gene expression activity from single DNA molecules. This system enables in vitro enzyme screening with unprecedently high accuracy. ● Autonomous artificial cell We have just launched this project with the aim to build artificial cells from purified biomolecules and/or synthetic molecules. Currently, we developed autonomously growing artificial cell reactor system.
Supervisors	YAMAGUCHI LAB.
Kazuya YAMAGUCHI, Professor Hiroaki KOBAYASHI, Associate Professor Takafumi YATABE, Lecturer	In our laboratory, we mainly conduct research on catalysis- and battery-related topics, focusing on the following three themes: (i) Development of highly efficient molecular transformation reactions by exploiting the unique features of heterogeneous catalysts; (ii) development of green chemical production processes from biomass resources; and (iii) development of next-generation cathode materials for energy storage free from critical resource constraints. <u>(i) Development of highly efficient molecular transformation reactions by exploiting the unique features of heterogeneous catalysts</u> We are developing new reactions using solid catalysts such as metal nanoparticles, including challenging oxidation reactions and the synthesis of functional molecules via partial transformation of compounds with common core structures. By utilizing unique reaction environments derived from solid surfaces, we aim to achieve high selectivity and precise reaction control that are difficult to realize with homogeneous catalysts, thereby constructing step-economical and environmentally benign synthetic processes. <u>(ii) Development of green chemical production processes from biomass resources</u> We are developing integrated processes to produce valuable green chemicals (such as liquid synthetic fuels) by using feed gases derived from forest biomass (CO and CO_2) as carbon-neutral carbon sources together with hydrogen produced from renewable energy. <u>(iii) Development of next-generation cathode materials for energy storage free from critical resource constraints</u> We focus on developing resource-abundant next-generation rechargeable batteries with energy densities comparable to those of current lithium-ion batteries. In particular, our research centers on cathode materials for sodium-ion and magnesium-metal rechargeable batteries. By employing earth-abundant redox-active elements, such as iron, manganese, and oxygen, we design and develop novel high-energy cathode materials—for example, ultrasmall nanomaterials and alkali-superrich oxides.

Supervisors	YANAGIDA LAB.
Takeshi YANAGIDA, Professor Tsunaki TAKAHASHI, Associate Professor Takuro HOSOMI, Associate Professor	In nature, there is a highly sophisticated mechanism that creates overwhelming functions by assembling various types of atoms and molecules by themselves while interacting with the surrounding environment in a complicated manner. Our laboratory, based on the physical chemistry of inorganic materials, device chemistry, and molecule chemistry, aim to understand and utilize such nanoscale “spatial material design principle”. These inorganic and organic materials can be spatially designed via the “interface events”. Furthermore, we aim to monitor spatially the multi-component molecules around us by integrating those new material properties (robust molecular recognition functions, etc.) with integrated devices and information science. We also are challenging to develop new research fields and industries that chemistry complex interacting systems. Specific ongoing research themes are listed below. 1. Development of inorganic / organic nanomaterial design method based on spatially selective crystal growth 2. Creation of robust molecular recognition interface 3. Development of single nanostructure property measurements 4. Creation of integrated molecular recognition electronics 5. Approaches of complex systems science via spatiotemporal measurements of multi-component molecules
Supervisors	NISHIBAYASHI LAB.
Yoshiaki NISHIBAYASHI, Professor Yasuomi YAMAZAKI, Lecturer Yoshiaki TANABE, Project Lecturer	Our laboratory is working on the development of molecular transformations mediated by bio-inspired molecular catalysts to yield useful molecules efficiently, which are capable of solving global challenges in energy and environment facing humanity on a global scale. Based on organometallic chemistry, our aim is design and development of nitrogen fixation, ammonia decomposition, reduction of carbon dioxide, and novel reactions including asymmetric synthesis. We are challenging the generation of new energy resources and an innovative social system based on these molecules. 1. Innovation of New Energy Resources and Foundation of New Social Systems 2. Development of New Catalysis Technology to Convert Dinitrogen and Carbon Dioxide into Resources 3. Development of New Catalysts as Solutions to Shortage of Energy Resources Keywords: organic chemistry, catalysts, molecular complexes, organometallic chemistry, organic synthesis, nitrogen fixation, ammonia, energy and environment

Supervisors	UEMURA LAB.
Takashi UEMURA, Professor Nobuhiko HOSONO, Associate Professor	All naturally occurring polymers are produced through enzymatic catalysis, where stereo-, regio-, and chemoselective reactions proceed effectively within regulated and well-organized molecular-scale spaces. Inspired by these elegant operations in biological systems, our research group has been developing new methodologies to control the structures of polymers and nanomaterials using microporous compounds, such as MOF, COF, and organic cages. The use of their designable nanopores for materials synthesis can facilitate multi-level structural control over the products. In addition, construction of the host-guest nanocomposites provides unprecedented material platforms to accomplish many nanoscale functions.
Supervisors	KIM LAB.
Yousoo KIM, Professor Emiko KAZUMA, Associate Professor	The excitation of molecules on solid surfaces leads to various energetic processes, such as transfer, conversion, and dissipation. Thus, a detailed understanding of the excited quantum states of the molecules is crucial to improving and developing organic energy conversion devices/systems based on (opto)electronic and/or (photo)chemical processes. Our research focuses on (1) real-space observation of surface reaction processes at the single-molecule level, (2) single-molecule measurement of quantum states involved in the processes, and (3) exploration of the selective control of reaction pathways and physicochemical properties of molecular interfaces. The main research topics are as follows. 1. Real-space observation of surface reaction processes at the single-molecule level 2. Development of novel single-molecule spectroscopy and measurement of physicochemical properties 3. Development of novel catalytic surfaces 4. Development of a surface analytical evaluation system for surface reactions 5. Comprehensive investigation of surface reactions based on computational science and experiment

Supervisors	FUJITA LAB.
Makoto FUJITA, Distinguished Professor Hiroki TAKEZAWA, Associate Professor Takaaki MITSUHASHI, Project Lecturer	Weak interactions induce the spontaneous organization of various biological structures such as DNA duplexes and protein nanostructures. We are translating such an elegant nature's mechanism into design principle for artificial molecular assemblies by showing the self-assembly of well-designed molecules into functional molecular systems. 1. Self-Assembling Molecular Systems Utilizing Transition Metals: Discrete coordination frameworks are self-assembled from metal ions and well-designed organic compounds. We have successfully constructed unique frameworks in nanoscale such as macrocycles, cages, capsules, nanotubes, and giant spheres. 2. Chemistry of the Confinement Effects: Chemically and physically new phenomena have been developed within the nano-sized cavity of the self-assembled hollow compounds. 3. Innovative Molecular Structure Analysis Utilizing Crystalline Nano Cavities: Through the studies on molecular recognition in solid state by analogy with solution chemistry, we have developed a new, crystallization-free, single crystal X-ray analysis method that is applicable for trace amount of and/or non-crystallizing compounds.
Supervisors	TATSUMA LAB.
Tetsu TATSUMA, Professor	Our research interests include photofabrication of metal and semiconductor nanostructures and development of novel photofunctional materials and devices, on the basis of new photonic and electrochemical phenomena. 1. Plasmon-induced charge separation (PICS) PICS, which we have discovered and which can be used for photoelectric conversion and photocatalysis, are studied for its mechanisms and potential applications. 2. Photonic nanofabrication Nanoscale photo-processing for metals and semiconductors beyond the diffraction limit is developed by coupling optical near field with chemical reactions. 3. Nanophotonics Nanomaterials for manipulating light, including metamaterials, is developed on the basis of interaction between matter and light. 4. Photocatalysis Novel photocatalystis are developed on the basis of the photonic nanofabrication techniques and nanophotonics. 5. Light emitting materials and devices Colloidal quantum dots are chemically synthesized and applied to self-emission-type light emitting diodes (QD-LED) and displays. 6. Other optical materials Nanomaterials for control of light absorption are developed for application to color displays, data storage, and smart windows.

Supervisors	ISHII LAB.
Kazuyuki ISHII, Professor	Our lab, Functional Metal Complexes Chemistry, aims to pioneer new scientific fields by fusing photochemistry, spin chemistry, and coordination/supramolecular chemistry. For example, photochemistry of metal complexes has attracted attention in terms of organic EL and artificial photosynthesis. Also, spin chemistry in photochemical processes became important for developing photofunctional molecules. Based on them, we are developing novel functional materials. Our research themes are as follows. 1. Research on Porphyrins and Phthalocyanines: Porphyrins, the basic skeleton of chlorophyll in photosynthesis and heme of hemoglobin, play important roles in biological systems. Phthalocyanines are practically used as blue/green dyes or pigments, photoconductors in photocopiers, and optical memory materials. We are preparing new porphyrins or phthalocyanines, and investigating their photochemistry and photofunctions. 2. Research on Molecular Chirality: Chirality is essential for developing pharmaceuticals and materials. In particular, we are investigating molecular chirality in terms of "homochirality of life", which is related to the origin of life. 3. Development of Biofunctional Molecules for Cancer Therapy: We are developing photosensitizers for photodynamic therapy and luminescent probes for detecting antioxidants in biological systems. 4. Soft Crystals: We proposed the concept of "Soft Crystals", which are different from conventional hard crystals and liquid crystals, and are investigating them. 5. Development of materials for adsorbing radioactive species: We are developing materials for adsorbing radioactive species, such as cesium ion, using Prussian Blue complexes.
Supervisors	SUNADA LAB.
Yusuke SUNADA, Professor	Subnano or Nanosized metal compounds (Metal clusters) have attracted much interests owing to their own unique properties attributed to the nanosized effect. Our research interests focus on the design and synthesis of a series of well-defined nanosized transition metal clusters, and their application as functional materials. 1. Synthesis of subnano- or nanosized metal clusters based on the template synthesis 2. Elucidation of the detailed chemical as well as physical properties of the metal clusters 3. Application of the metal clusters in a variety of catalysis 4. Synthesis of new functional metal clusters consisting of both transition metal and the main group elements

Supervisors	TSUKAMOTO LAB.
Takamasa TSUKAMOTO, Lecturer	The nature of 'quantum-sized materials', which are ultrasmall nanoparticles with 1 nm diameter exhibiting the quantum size effect, have not been clarified sufficiently yet because of the technical difficulty of their synthesis. In this laboratory, we investigate the development of synthetic methods and properties of such materials by utilizing the knowledge of both organic and inorganic chemistry. 1. Development of synthetic method for quantum-sized materials 2. Evaluation of physical and chemical properties of quantum-sized materials 3. Development of atomic-level chemical reactions 4. Construction of concept of atom-analogy
Supervisors	TAKEYA LAB.
Junichi TAKEYA, Professor Yasunari TAMAI, Associate Professor Shusaku IMAJO, Associate Professor	In the development of next-generation electronic devices, it is needed to consider their compatibility to the environment and demands for their diverse functions because of the rapid structural change in human society. Recently, organic semiconductor devices are attracting much attention as a practical candidate to meet such requirements because of their simple and low-cost production processes, low environmental burden, as well as for their unique function of flexibility. The scope of our research group ranges from basic scientific studies on materials chemistry and charge transport physics in organic semiconductor interfaces to the device functionalization and engineering of organic semiconductors. 1. Starting from developing new organic semiconductor materials, we study fundamental charge transport properties to eventually develop high-speed organic transistors utilizing organic single-crystal semiconductors developed in our group. Combining specialties in condensed matter physics, and device engineering, we create innovative electronics through synergistic effects. 2. We promote industrialization of the novel high-performance organic electronics in collaboration with various private companies. Our own start-up companies develop markets of integrated circuits for flexible display panels and IoT sensor tags in collaboration with various industries from chemistry to services.

Supervisors	UCHIDA LAB.
Ken-ichi UCHIDA, Professor Yusuke NAKANISHI, Associate professor	Uchida Laboratory is conducting research on "spin caloritronics" based on the fusion of spintronics and thermoelectric/thermal transport properties. We are developing new thermal energy conversion, control, and transfer phenomena and functionalities driven by the concerted effects of electron transport, magnetism (spin), phonon, ferroelectricity, etc., and materials science to improve their energy conversion efficiency by introducing technologies and knowledge from interdisciplinary fields beyond the conventional framework of spintronics. We aim to contribute to the realization of a sustainable society by breaking new ground in spin caloritronics using our uniquely developed active thermal measurement and hybrid/composite material synthesis techniques as well as by bringing it to fruition in thermal management technologies. Examples of our current research themes are as follows: 1. Exploration of new materials, microstructure control, and synthesis of hybrid/composite materials for giant magneto-thermoelectric and thermo-spin effects 2. Control of thermal conduction by magnon engineering and spin currents 3. Investigation of transport properties in quantum materials and ferroelectrics 4. Development of nanoscale active thermal imaging measurement techniques 5. Development of high-performance transverse thermoelectric conversion modules
Supervisors	SUZUKI LAB.
Kosuke SUZUKI, Professor Yu YAMASHITA, Associate Professor	Materials surrounding us exhibit a wide variety of properties and functions arising from the arrangement of atoms and molecules and their mutual interactions. By precisely controlling elemental combinations and spatial arrangements at the atomic level, it becomes possible to create new materials with unprecedented functionalities. Our laboratory seeks to pioneer new directions in materials chemistry by employing advanced synthesis strategies that enable precise structural control from the atomic to the nanometer scale, beyond conventional materials synthesis. Through atomic- and molecular-level materials design and the elucidation of structure–function relationships, we aim to contribute to the solution of societal challenges, including energy and environmental issues. 1. We develop a new approach to precision inorganic synthesis based on polyoxometalates, molecular metal oxides that allow the number, composition, arrangement, and electronic states of metal atoms to be designed at the atomic level. Using this strategy, we create metal oxide clusters, metal clusters, and inorganic–organic hybrid materials with unique metal arrangements and electronic structures that are difficult to achieve in conventional materials, and explore their applications in efficient catalysis and photocatalysis, energy conversion, and emerging quantum functional materials. 2. We aim to establish a new concept of “molecular ionics” through molecular- and nanoscale interface design and the precise control of electron and ion transport properties. In particular, by focusing on molecular materials with multielectron redox activity, we are working toward the development of next-generation energy conversion and energy storage devices.