

Academic Year 2022

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 2022

Due to the effects of new coronavirus infection, *etc.*, it is possible that the contents of the Guidelines for Applicants 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 website, so you need to check it at any time.

Graduate School of Engineering Website: http://www.t.u-tokyo.ac.jp/soe/admission/general_guideline.html

Department of Applied Chemistry Website: https://www.appchem.t.u-tokyo.ac.jp/news_cat/admissions/

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)

Application accepted	From July 1 to 7, 2021
Examination dates ^{*1, *2}	From August 30 to 31, 2021 ^{*2}
Announcement of successful applicants	September 14, 2021

Doctoral Program

		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 July 1 to 7, 2021		From November 25, 2021 to December 1
Examination dates	First stage ^{*1}	From August 31, 2021 ^{*3}		January 18, 2022
	Second stage	Late January to mid-February 2022 ^{*4, *5}	At the same time as the first stage	At the same time as the first stage
Announcement of successful applicants		(September 14, 2021 for the first stage results) February 10, 2022	September 14, 2021	February 10, 2022

^{*1} If the examination is conducted online, online Pre-test will be held on the afternoon of August 29, 2021.

^{*2} We will make a decision in advance whether to pass or fail using the contents of "Questionnaire Sheet 1". The result will be notified separately (scheduled for early August).

^{*3} Refer to the Examination Dates specified in the 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.

^{*4} The dates will be announced later.

^{*5} For those who have been conferred, or are expected to be conferred on or before September 30, 2021, a Master's or a professional degree, the examination will be conducted at the same time as the first stage.

2. Implementation Methods, etc.

- 1) The examination for the master's program (General education subjects and Oral examination) and the first stage examination of application schedule A for the doctoral program (Specialized academic subjects and Oral examination) will be held on the specified examination sites (on the Hongo campus). Those who are unable to take the examination at the test site because they live outside Japan, or those who have an underlying medical condition that places them at high risk of serious COVID-19 infection, may be allowed to take the examination online. Applicants for the master's program who hope to take the examination online should submit the form "Application for the Online Written Examinations." Applicants for the doctoral program who hope to take the examination online should contact the director of Department of Applied Chemistry at the time of application. Those who have been approved to take the examination online cannot change to taking the examination at the test site. Applicants' Examination Admission Cards will notify them whether or not they may take the examination online, as well as details regarding the online examination. For those who are allowed to take the test online, a mandatory online pre-test will be held on the afternoon of August 29, 2021. Those who fail to participate will lose their eligibility for admission. From the standpoint of preventing fraud and ensuring the fairness, your entire online test session will be recorded and your photo will be taken.
- 2) The second stage examination for the doctoral program application schedule A and the examination for the doctoral program application schedule B will be announced separately.
- 3) The examination will be held at the examination room of the Graduate School of Engineering, the University of Tokyo (7-3-1 Hongo, Bunkyo-ku, Tokyo). You will be notified of the detailed information about the location when an examination admission ticket is sent.
- 4) Applicants must enter the designated examination room at least 15 minutes before the start of the examination.

※ In case of online implementation due to new coronavirus infection, etc.

- 1) You will be notified of the detailed information about the online examination separately (scheduled for early August).
- 2) Online pre-test will be held on the afternoon of August 29, 2021.

3. What to Keep during the Examination (for on-site examination)

- 1) Items you have to keep: Examination admission ticket, black pencil (or mechanical pencil), eraser.
- 2) Items you may keep: Pencil sharpener (table-top type not allowed) or knife and a watch (with timekeeping function only)
- 3) Turn off mobile phones and smartphones before entering the examination room, put them in a bag, and do not carry them in your pocket. Using them to check the time is not allowed.

4. Notes on the Written Examinations

- 1) Once the examination starts, you are not allowed to leave the room, even if you have completed answering all questions or if you decide not to take the examination.
- 2) Keep your examination admission ticket close at all times during the examination.
- 3) You are not allowed to take answer sheets and a question booklet out of the examination room.

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) A letter of acceptance will be mailed to each successful applicant. We do not answer any inquiries about acceptance or rejection by telephone or e-mail.
- 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 from those 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 Guideline and specify the order of preference on the **Questionnaire Sheet 2** (p. 12). Submit both questionnaires together with the application for admission.
3. Only those who pass the evaluation of "**Questionnaire Sheet 1**" can take the following examination. 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 several number of applicants who wish to proceed to a doctoral program at the same laboratory where they completed their master's program. Applicants wishing to go on to a doctoral program at their first laboratory should check the box in the " **I wish to go on to a doctoral program at the laboratory of my first choice. I have received guidance and an interview before applying, and have received approval from the faculty member.**" row at the bottom of Questionnaire Sheet 2. In addition, the applicants must contact the faculty member of the desired laboratory by June 8, 2021. Applicants must have guidance and an interview before applying, and must obtain the approval of the faculty member before applying.
5. Foreign nationals who have the qualifications listed in the application guideline of 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 June 8, 2021, 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 general selection 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 after the announcement of successful applicants.

Examination subjects (Second stage)	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 all three problems on the left. Questions related to analytical chemistry, polymer chemistry, and biochemistry may be included in any of the questions. <u>Applicants will select two of the three problems immediately after the examination, and the scores of the selected problems will be used for the pass/fail judgment and laboratory assignment.</u> (600 points)

3) Oral examination	<p>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.</p> <p style="text-align: right;">(100 points)</p>
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***1: [Notes on submitting an official TOEFL score]**

- Please check the application guidelines for the Graduate School of Engineering carefully.
- Applicants should submit an official TOEFL score from a test administered in September 2019 or later.
- When you register to take the TOEFL iBT or TOEFL iBT Home Edition, please send your request for an official score report to the address below. If you are submitting scores that have already been taken, please also ask ETS to send the official score report to the following address.

Where to send an official TOEFL score: We will not be able to verify scores sent outside of this code.

DI (Designated Institution) Code: "8596" (University of Tokyo Engineering)

Department Code: "99" (Any Department Not Listed)

- The Graduate School will not be able to check your score unless the sending procedure is completed. If the submission process is completed correctly and there are no problems with the examination itself, the Graduate School will be able to check the score data online approximately two weeks after the examination. When this data is available, the score is considered to have been submitted.

[Notes]

- Please enter the Appointment Number of the score report you plan to submit when you register to take the TOEFL before the application deadline for the Graduate School Admission Test and complete the Application Form. If you are submitting a score that has already been taken, you must also enter the Appointment Number from the score report that you plan to submit. If you have more than one score, only the score with the Appointment Number you entered in the application form will be valid.
- You do not need to submit a Test Taker Score Report.
- In principle, changes to the TOEFL score after the application has been submitted will not be accepted.
- In some cases, due to mechanical problems or other reasons given by the organizer, the test may have to be retaken or the disclosure of scores may be delayed, so please allow enough time to take the test.
- Please check the information on the ETS and CIEE websites and send your score well in advance to ensure that it arrives by the deadline.
- Adopt Test Date Scores (My Best Scores will not be utilized).
- If you wish to submit a TOEFL ITP Plus for China score, please submit a copy of the score that will be sent to your Vericant account with your graduate school application. In addition, please specify the Graduate School of Engineering (The University of Tokyo(Engineering)) as the recipient of the data from the "Send to Schools" page on the Vericant student portal site.

**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 from those 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 must contact in advance the academic supervisor whom they want to be guided by in the program and receive guidance and an interview.
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 Guidelines for Applicants 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 Guideline 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} 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	Essay type examination on specialized academic subjects
3) Oral examination	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	Essay type examination on specialized academic subjects
3) Oral examination	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 an official TOEFL score from a test administered in September 2019 or later.
Application Schedule B: Applicants should submit an official TOEFL score from a test administered in February 2020 or later.
Refer to the **【Notes on submitting an official TOEFL score】** in the Note on Page 4.
- *3: The score must be 61 in iBT or above.

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 already acquired a master's or professional degree at the time of application or who are expected to acquire one by September 30, 2021, an oral examination in the first-stage examination will also play the role of the second-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.

List of Laboratories

Number of students to be admitted in academic year 2022

Master's program: 33

Doctoral program: 13

Department	Name of Laboratory
Graduate School of Engineering	<u>Fujita Laboratory</u> , <u>Noji Laboratory</u> , <u>Yamaguchi Laboratory</u> , <u>Yanagida Laboratory</u> , <u>Nishibayashi Laboratory</u> , <u>Uemura Laboratory</u>
Research Center for Advanced Science and Technology	<u>Ishikita Laboratory</u>
Institute of Industrial Science	<u>Fujioka Laboratory</u> , <u>Tatsuma Laboratory</u> , <u>Ishii Laboratory</u> <u>Sunada Laboratory</u>
Graduate School of Frontier Sciences	<u>Ito Laboratory</u> (also serves as a lab in Graduate School of Engineering) <u>Takeya Laboratory</u> (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 several number of applicants who wish to proceed to a doctoral program at the same laboratory where they completed their master's program. Applicants wishing to go on to a doctoral program at their first laboratory should check the box in the " **I wish to go on to a doctoral program at the laboratory of my first choice. I have received guidance and an interview before applying, and have received approval from the faculty member.**" row at the bottom of Questionnaire Sheet 2. In addition, the applicants must contact the faculty member of the desired laboratory by June 8, 2021. Applicants must have guidance and an interview before applying, and must obtain the approval of the faculty member before applying.

Dates of Examinations

Program	Examination Subjects	Date and Time	Remarks
Master's Program (Second-stage examination)	Foreign languages English		- Submit your official TOEFL score. - There will be no written test at the venue.
	Regular education subjects Chemistry	August 31 From 14:30	- Answer all three questions: physical chemistry, inorganic chemistry, and organic chemistry (40 minutes for each problem). <u>Applicants will select two of the three problems immediately after the examination, and the scores of the selected problems will be used for the pass/fail judgment and laboratory assignment.</u>
	Oral examination	August 30 From 9:00	- Arrive at the venue 15 minutes earlier. - 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	August 31 From 9:00 to 11:00
		Oral examination *2	August 31 From 13:00
	Second-stage examination *3,*4,*5	Late January to mid- February 2022	- 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	January 18, 2022 From 13:00 to 15:00	
	Oral examination *5	January 18, 2022 From 15:30	- 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" and "general education subjects".

*2. 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.

*3. For those who have already acquired a master's or professional degree at the time of application or who are expected to acquire one by September 30, 2021, an oral examination in the first-stage examination will also play the role of the second-stage examination.

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

*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.

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. The **Questionnaire Sheet 1** (p.10, p.11) should be submitted in double-sided printing.】

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:		
<p>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.</p> <p>【To master's program applicants】 The pass/fail judgment is performed using the described contents. In addition, these contents will be used as a reference for the oral examination.</p>			

<Questionnaire Sheet 1 continued>

Name of an academic supervisor you want to be guided by (for applicants to the doctoral program only)	
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* 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 several number of applicants who wish to proceed to a doctoral program at the same laboratory where they completed their master's program. Applicants wishing to go on to a doctoral program at their first laboratory should check the box in the “ **I wish to go on to a doctoral program at the laboratory of my first choice. I have received guidance and an interview before applying, and have received approval from the faculty member.**” row at the bottom of Questionnaire Sheet 2. In addition, the applicants must contact the faculty member of the desired laboratory by June 8, 2021. Applicants must have guidance and an interview before applying, and must obtain the approval of the faculty member before applying.
- 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
	Fujita Laboratory		Noji Laboratory		Yamaguchi Laboratory
	Yanagida Laboratory		Nishibayashi Laboratory		Uemura Laboratory
	Ishikita Laboratory		Fujioka Laboratory		Tatsuma Laboratory
	Ishii Laboratory		Sunada Laboratory		Ito Laboratory
	Takeya Laboratory		\		\

I wish to go on to a doctoral program at the laboratory of my first choice. I have received guidance and an interview before applying, and have received approval from the faculty member.

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
	Fujita Laboratory		Noji Laboratory		Yamaguchi Laboratory
	Yanagida Laboratory		Nishibayashi Laboratory		Uemura Laboratory
	Ishikita Laboratory		Fujioka Laboratory		Tatsuma Laboratory
	Ishii Laboratory		Sunada Laboratory		Ito Laboratory
	Takeya Laboratory		/		/

I declare that my order of preference is as above.

Name of Applicant

Supervisors	FUJITA LAB.
<p>Makoto FUJITA, Distinguished professor (5841-7259)</p> <p>Sota SATO, Project professor (5841-7256)</p> <p>Tomohisa SAWADA, Associate professor (5841-0365)</p>	<p>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.</p> <ol style="list-style-type: none"> 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	NOJI LAB.
<p>Hiroyuki NOJI, Professor (5841-7252)</p> <p>Kazuhito TABATA, Associate professor (5841-7252)</p> <p>Mika KOBAYASHI Project lecturer (5841-7252)</p>	<p>The main fields of our research are nanobioscience and nanobiotechnology; single-molecule biophysics, single-molecule diagnostics, femto-reactor systems for cell-free synthetic biology including build-a-cell project.</p> <ul style="list-style-type: none"> ● 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. Our works are widely featured in the textbooks of molecular biology, cell biology, biochemistry, and biophysics as the first demonstration of the rotation of ATP synthase. ● Single-molecule digital bioassay We developed femto-liter reactor technology that enables single-molecule enzymatic assays. This technology is currently utilized for single-molecule immunoassay termed '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 unprecedentedly 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.
<p>Kazuya YAMAGUCHI, Professor (5841-7197)</p> <p>Noritaka MIZUNO, Project professor (5841-7272)</p> <p>Kosuke SUZUKI, Associate professor (5841-7274)</p> <p>Yoshinobu NAKAMURA, Lecturer (5841-7462)</p>	<p>Our laboratory mainly focuses on research topic related to catalysis: 1) development of high-performance solid catalysts for environmentally friendly high-efficiency reactions, 2) precise design of multinuclear metal oxide catalysts using polyoxometalates as molecular templates, 3) conversion of natural carbon resources such as methane</p> <p>As for topic 1, we engage in research on the development of high-performance heterogeneous catalysts for highly efficient liquid-phase organic reactions, especially for catalytic oxidation reactions. Our targets are highly difficult new oxidation reactions such as dehydrogenation, oxygenation, and dehydrogenation cross-coupling by direct activation of C–H and X–H (X is a heteroatom) bonds, and tandem oxidation reactions by using O₂ or without using any oxidants. To realize these reactions, we are designing and developing polyoxometalate molecular catalysts, crystalline nano-oxide catalysts, and metal nanoparticle catalysts.</p> <p>As for topic 2, we engage in research on the design of the inorganic materials that can precisely and freely control the number, composition, and arrangement of metal atoms in the mononuclear to multinuclear metal clusters. We are also studying the application of the designed polyoxometalates having multinuclear metal clusters to catalysis (organic synthesis), photocatalysis, and molecular magnetism.</p> <p>As for topic 3, we engage in research on the developing chemical conversion (oxidation reaction) of abundant natural carbon resources (mainly C1-C4 alkanes). For example, we aim to convert methane to methanol in one step with high yield and high selectivity using O₂ as the oxidant.</p>
Supervisors	YANAGIDA LAB.
<p>Takeshi YANAGIDA, Professor (5841-8939)</p> <p>Kazuki NAGASHIMA, Associate professor (5841-3840)</p> <p>Tsunaki TAKAHASHI, Project Associate Professor (5841-3840)</p>	<p>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.</p> <ol style="list-style-type: none"> 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.
<p>Yoshiaki NISHIBAYASHI, Professor (5841-7708)</p>	<p>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, and novel reactions including asymmetric synthesis.</p> <p>We are challenging the generation of new energy resources and an innovative social system based on these molecules.</p> <ol style="list-style-type: none"> 1. Innovation of New Energy Resources and Foundation of New Social Systems 2. Development of New Catalysis Technology to Convert Ammonia into Resources 3. Development of New Catalyses as Solutions to Shortage of Energy Resources <p>Keywords: organic chemistry, catalysts, molecular complexes, organometallic chemistry, organic synthesis, nitrogen fixation, ammonia, energy and environment</p>
Supervisors	UEMURA LAB.
<p>Takashi UEMURA, Professor (04-7136-3786)</p> <p>Nobuhiko HOSONO, Lecturer (04-7136-3791)</p>	<p>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.</p>

Supervisors	ISHIKITA LAB.
<p>Hiroshi ISHIKITA, Professor (5452-5056)</p> <p>Keisuke SAITO, Associate professor (5452-5056)</p> <p>Hiroyuki TAMURA, Project Associate professor (5452-5082)</p>	<p>The energy of life activity is ultimately generated by chemical reactions at active sites in biomolecules. For the active site, transition metal complexes (Mn, Fe, Co, Mo, Zn, etc.) and large π-conjugated molecules are used. By arranging these molecules appropriately in the protein electrostatic environment, which have been optimized during the course of evolution, extremely high-efficiency reactions can be achieved under mild conditions. Using theoretical approaches, we 1) clarify reaction mechanisms based on molecular chemistry and 2) facilitate molecular design such as drug discovery and new high-performance device design. The more complex and experimentally difficult molecules (eg, ~100,000 atoms in the water-splitting enzymes) are, the more the theory has an opportunity to play an active part in research.</p> <ol style="list-style-type: none"> 1. photosynthetic reaction center proteins and metal proteins <ul style="list-style-type: none"> • Water splitting and oxygen evolution in the Mn_4CaO_5 complex, artificial photosynthesis • Electron transfer reaction, proton (H^+) transfer reaction • Photoexcitation, photoprotection 2. Drug discovery (target protein, molecular design) <ul style="list-style-type: none"> • Drug design for cancer factors, blood pressure adjustment, etc. 3. Fiberless optogenetics <ul style="list-style-type: none"> • Development of optical sensor protein and demonstration on mouse 4. • Simulation for new material development
Supervisors	FUJIOKA LAB.
<p>Hiroshi FUJIOKA, Professor (5452-6342)</p> <p>Atsushi KOBAYASHI Project Associate Professor (5452-6344)</p>	<p>We are developing next-generation devices for a sustainable energy and information society based on GaN technologies for blue LEDs, power electronics, and quantum information devices. Until now, electronic devices have been made from single crystals of hard and brittle semiconductors such as Si, and their applications have been limited to personal computers and mobile phones. On the other hand, we are developing a new technique to synthesize high-quality GaN thin films on substrates with completely different chemical properties. This technology will enable structural materials such as organic polymers, glass, and metal foils, which have not previously been used as materials for electronics, to be given intelligent functions such as arithmetic, luminescence, power generation, and communication. Our goal is to contribute to the realization of a low environmental impact information society by developing new functional elements that are light and flexible using chemical methods. The research themes for next year are as follows.</p> <ol style="list-style-type: none"> 1. Development of organic/inorganic micro LED display as a substitute for organic EL 2. Development of high-efficiency full-color LEDs and UV LEDs for medical use 3. Fabrication of high-efficiency nitride solar cells 4. Development of power electronics for car electronics 5. Development of organic polymer-based electronics 6. Development of materials for quantum devices of artificial intelligence (AI)

Supervisors	TATSUMA LAB.
Tetsu TATSUMA, Professor (5452-6336)	<p>Our research interests include development of novel photofunctional materials and devices on the basis of photonic and electronic characteristics of nanostructures.</p> <ol style="list-style-type: none"> 1. Basic studies on plasmon-induced charge separation (PICS) Mechanistic studies on PICS, which we reported for the first time, for improvement of efficiency and development of new applications. 2. Photovoltaic applications PICS is applied to photovoltaic cells, photodetectors, and image sensors. It is also applied to infrared photovoltaics. 3. Photocatalysis Plasmonic photocatalysis and semiconductor photocatalysis are developed for hydrogen generation, deactivation of bacteria and viruses, and so on. 4. Nanophotonic fabrication Fine processing beyond the diffraction limit is developed and applied to fabrication of chiral nanostructures for novel photocatalysts and metamaterials. 5. Light emitting materials and devices Colloidal quantum dots are synthesized and applied to light emitting diodes (QLED) and displays. 6. Other optical materials Nanomaterials for control of light absorption are developed for application to color displays, data storage, and smart windows. Advanced coloring materials are also developed.
Supervisors	ISHII LAB.
Kazuyuki ISHII, Professor (5452-6306)	<p>Discovery and clarification of novel electronic structures are important not only for pioneering new scientific field but also in terms of developing new functions. Metal complexes are promising for designing electronic structures because it can show various electronic states. In our laboratory, we are pioneering new scientific fields by fusing coordination chemistry, photochemistry, and spin chemistry, and are also creating novel functions of organic–inorganic hybrid materials.</p> <p>Our targets are porphyrin and phthalocyanine complexes: the former is the basic skeleton of heme of hemoglobin and chlorophyll in photosynthesis, and the latter is practically used as blue/green dyes or pigments, photoconductors in photocopiers, and optical memory materials. We are investigating them by synthesizing functional complexes, spectroscopically measuring them (e.g. electronic absorption, luminescence, circular dichroism, magnetic circular dichroism, electron spin resonance, various time-resolved measurement, etc.) and analyzing them in detail based on quantum chemical calculations. Our research themes are as follows:</p> <ol style="list-style-type: none"> 1. Development of functional porphyrin and phthalocyanine complexes 2. Development of photofunctional metal complexes 3. Development of biofunctional molecules for treating cancer 4. Development of new photofunctional materials based on molecular magnetism 5. Development of materials for adsorbing radioactive species

Supervisors	SUNADA LAB.
<p>Yusuke SUNADA, Associate professor (5452-6361)</p>	<p>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.</p> <ol style="list-style-type: none"> 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	ITO LAB.
<p>Kohzo ITO, Professor (04-7136-3756)</p> <p>Hideaki YOKOYAMA, Associate professor (04-7136-3766)</p>	<p>In Ito & Yokoyama laboratory, we study the material group called "soft materials" such as polymers, liquid crystals, and biological molecules. They are characterized by self-assembling higher order structures changing with external stimuli. Especially, we are focusing on the 'slide-ring materials' system having supramolecular-polymer-network structure, on pseudo-polyrotaxane nanosheet, and on the block copolymer system.</p>

Supervisors	TAKEYA LAB.
<p data-bbox="162 573 384 680">Junichi TAKEYA, Professor (04-7136-3787)</p> <p data-bbox="162 810 432 918">Toshihiro OKAMOTO, Associate professor (04-7136-3765)</p>	<p data-bbox="454 273 1412 618">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.</p> <ol data-bbox="454 631 1412 976" style="list-style-type: none"> 1. Starting from synthesizing 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 synthetic organic chemistry, 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.