

# 材料化学専攻

・志望区分

志望区分	講座・分野
	(材料化学専攻)
1	機能材料設計学講座
2	無機材料化学講座 無機構造化学分野
3	無機材料化学講座 応用固体化学分野
4	有機材料化学講座 有機反応化学分野
5	有機材料化学講座 天然物有機化学分野
6	有機材料化学講座 材料解析化学分野
7	高分子材料化学講座 高分子機能物性分野
8	高分子材料化学講座 生体材料化学分野
9	ナノマテリアル講座 ナノマテリアル分野

・募集人員

材料化学専攻 7名

・出願資格

募集要項4ページ「出願資格」参照

・学力検査日程

(1)試験日時・試験科目

(a)一般

2月12日(水)	10:00~11:00 英語	12:30~15:30 専門科目
2月13日(木)	10:00~ 研究経過の発表及び口頭試問	

(b)社会人特別選抜

2月13日(木)	13:00~ 研究経過の発表及び口頭試問
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(2)試験場

試験は桂キャンパスAクラスターで行う。詳細は受験票郵送時に指示する。

・入学試験詳細

試験室には必ず受験票を携帯し、係員の指示に従うこと。

(1)筆記試験(試験開始15分前までに入室のこと)

(a)専門科目においては、無機化学・物理化学・有機化学・分析化学・高分子化学の5科目中2科目を選択して解答すること。

(b)それぞれの専門科目受験に際して、自分の電卓使用は許可しない。

(c)英語科目においては、辞書の持ち込みを認めない。

(d)携帯電話等の電子機器類は、なるべく試験室に持ち込まないこと。持ち込む場合には、電源を切り、かばんにしまって所定の場所に置くこと。身につけている場合、不正行為とみなされることがあるので注意すること。

(e)筆記具は鉛筆、万年筆、ボールペン、シャープペンシル、鉛筆削り、消しゴムに限る。



・教育プログラムの内容について

【高度工学コース】

科学技術にもとづく社会の高度発展にともない、新物質や新材料開発に対する要請がますます強くなっています。これらが現在の生活および産業基盤を支えていること、また先端化学が将来果す役割にますます期待が膨らんでいることにほかなりません。化学は、新物質を作る技術に加えて、物質を構成する分子の生い立ちや性質を調べ、物質特有の機能を探索する学問に変貌しつつあります。

材料化学専攻では無機材料、有機材料、高分子材料を中心に、構造と性質を分子レベルで解明しながら、新機能をもつ材料を設計するとともに、その合成方法を確立することを目的として研究・教育をおこなっています。博士後期課程では、独創的な発想と明敏な洞察力により積極的に材料化学の新領域を切り拓く能力をもった化学者・化学技術者を育成します。

・その他

(1)受験票は募集要項にある通り受験票送付用封筒に記入された住所へ 2 月上旬に郵送される。

(2)試験当日受験票を忘れた受験生は、速やかにAクラスター事務区教務掛にその旨を申し出ること。

(3)問合せ先・連絡先

〒615-8510 京都市西京区京都大学桂

京都大学大学院工学研究科 A クラスター事務区教務掛（材料化学専攻）

電話：075-383-2076 075-383-2077

E-mail：090kakyomu@mail2.adm.kyoto-u.ac.jp

参照：http://www.mc.t.kyoto-u.ac.jp/ja

(4) 研究内容説明

区分	講座・分野 / 研究内容 【材料化学専攻】 <a href="http://www.mc.t.kyoto-u.ac.jp/ja">http://www.mc.t.kyoto-u.ac.jp/ja</a>	対応する教育プログラム	
		連携教育プログラム (融合工学コース)	連携教育プログラム (高度工学コース)
1	機能材料設計学講座 (機能材料設計・無機合成化学・物性化学) 1. 新規機能性酸化物の合成・構造解析・物性評価 2. 層状化合物の構造・物性相関の理解と機能探索 3. 酸化物薄膜成長とデバイス応用 4. ナノ材料の合成と機能化	物質機能・変換科学分野  総合医療工学分野	材料化学専攻の定める教育プログラムに従う
2	無機材料化学講座 無機構造化学分野 (無機構造化学・レーザー科学・アモルファス工学・機能性ナノ材料) 1. 超短パルスレーザーと物質との相互作用 2. 無機ガラスの非平衡熱物性 3. ナノ材料合成と機能化 4. 半導体単結晶の低温変形		
3	無機材料化学講座 応用固体化学分野 (応用固体化学・無機固体物性・機能性無機材料) 1. 酸化物の磁性・磁気光学・スピントロニクス 2. 新しいマルチフェロイクスの開拓 3. ナノ構造を持つ金属・非金属のプラズモニクス 4. ナノ構造を持つ半導体・誘電体による光機能の創出		
4	有機材料化学講座 有機反応化学分野 (有機反応化学・立体化学・有機合成化学・有機金属化学・有機材料化学) 1. 有機機能材料の開拓 2. 高選択的有機合成反応 3. 有機分子触媒の特性を利用した新合成反応 4. 有機金属化合物の開拓と有機反応への応用		
5	有機材料化学講座 天然物有機化学分野 (天然物有機化学・有機合成・有機金属・触媒反応・電子共役有機材料・有機元素化学) 1. ヘテロ元素の特性を活用する機能材料合成 2. 新しい有機金属化合物の合成と機能探索 3. 生物活性有機化合物の合成 4. 遷移金属錯体を用いる触媒反応		
6	有機材料化学講座 材料解析化学分野 (マイクロ/ナノ分離科学・材料解析化学・機器分析化学・高分離能分析) 1. ミクロスケール液相分離法の高性能化・高機能化 2. 機能性材料の開発とマイクロ分析への応用 3. 微細加工技術による新規分析システムの開発 4. 分離科学における特異的相互作用の利用		
7	高分子材料化学講座 高分子機能物性分野 (高分子レオロジー・多相系高分子材料・生体材料物性・生体組織工学) 1. 高分子材料の分子構造とレオロジー的性質 2. 高分子ゲルの物理化学 3. 高分子不均質系の相構造と物理的性質 4. 生体関連物質及び生体組織の力学特性		
8	高分子材料化学講座 生体材料化学分野 (高分子材料化学・生体材料化学・機能性高分子・生体機能材料) 1. 多様なモルフォロジーと特性を有する分子集合体 2. ペプチドベースの分子デバイス 3. 免疫系をモジュレートするナノキャリア 4. 糖鎖工学		
9	ナノマテリアル講座 ナノマテリアル分野 (ナノセンシングデバイス・ナノ構造体の電子移動特性・溶液内及び界面電子移動反応・分光電気化学分析) 1. ナノセンシングデバイスの構築と機能評価 2. 導電性ナノ構造体の電子移動特性の解析 3. 溶液内電子移動反応と電極電子移動反応の相関解明 4. 有機電極反応で生成する活性種の電気化学及び分光分析		

*The Japanese language version of the information provides here is to be given precedence.*

## Department of Material Chemistry

### I. Preferred Research Area

Preferred Research Area	Chair/Laboratory
1	(Department of Material Chemistry) Functional Materials Design
2	Inorganic Material Chemistry, Inorganic Structural Chemistry
3	Inorganic Material Chemistry, Industrial Solid-State Chemistry
4	Organic Material Chemistry, Organic Reaction Chemistry
5	Organic Material Chemistry, Organic Chemistry of Natural Products
6	Organic Material Chemistry, Analytical Chemistry of Materials
7	Polymer Material Chemistry, Polymer Physics and Function
8	Polymer Material Chemistry, Biomaterial Chemistry
9	Nanomaterials, Nanomaterials

### II. Enrollment Capacity

Department of Material Chemistry: 7 people

### III. Eligibility requirements for applicants

Refer to “II-i. Eligibility” on page 17 of the Guidelines for Applicants.

### IV. Examination Schedule

(1) Date and time, and subjects for examination

(a) General Selection

February 12 <sup>th</sup> (Wed)	10:00 a.m. - 11:00 a.m. English	12:30 a.m. - 3:30 p.m. Specialist Subjects
February 13 <sup>th</sup> (Thu)	From 10:00 a.m. Research Progress Presentation and Oral Exam	

(b) Special Selection of Career-Track Working Students

Thursday, February 13	From 1:00 p.m. Research Progress Presentation and Oral Exam
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(2) Examination venue

The examination will be conducted in the A Cluster in Katsura Campus. For the details, instructions are given in the examination vouchers to be sent at a later date.

### V. Details of Entrance Examinations

Applicants must carry their examination vouchers in the examination room and follow the instructions given by the attendant.

(1) Written examination

(Applicants must enter the examination room no later than 15 minutes before the examination starts.)

- For Specialist Subjects, two subjects must be selected from the five subjects of Inorganic Chemistry, Physical Chemistry, Organic Chemistry, Analytical Chemistry, and Polymer Chemistry.
- Applicants are not permitted to use their own calculators in taking the examinations in the Specialist Subjects.
- It is not allowed to carry in dictionaries for the English examination.
- Applicants are advised, preferably, not to carry any electronic devices, such as mobile phones, into the examination room. If they carry such devices into the examination room, turn the devices off, put them in their bags, and place the bags at the specified place. Note that keeping an electronic device at hand may be considered to be a misconduct.
- Writing tools allowed to be used in the examination are only pencils, fountain pens, ball-point pens, mechanical pencils, pencil sharpeners, and erasers.

- (2) Oral examination (Applicants must enter the examination room no later than 15 minutes before their presentations.)
  - (a) In the oral examination, each applicant is required to explain research progress over the past years. After the examinees' explanation, oral examination will be given by faculty members. The oral examination basically takes approximately 30 minutes, including an explanation by the applicant for 20 minutes and questions and answers for the rest of the time.
  - (b) Basically, applicants must not read a manuscript when explaining research progress.
  - (c) Applicants may use a projector for PC as a supplementary tool; therefore, they must prepare a MS Power Point file as necessary. (The deadline and address for submission of data will be notified directly to applicants at a later date.)
  - (d) Applicants other than those who graduate from the Department of Material Chemistry will take oral examination (interview) in another room.

## **VI. Application Procedure for Admission**

- (1) Before applying for this department, applicants must contact a representative person in the laboratory of their choice.
- (2) Applicants must select the research area of their choice on the information entry screen of the Internet Application System. For the details on researches of each area, refer to "(4) Research Descriptions" in "IX. Other".
- (3) Applicants must summarize an outline of their past research progress (1000 to 1200 words; figures and charts may be included) in up to five pages of A4-size paper and submit eight copies to A Cluster Office, Graduate Student Section (Department of Material Chemistry), by mail or hand no later than noon on Friday, January 31. The timetable for oral examination will be notified directly to applicants at a later date.

\*Applicants other than those who graduate from the chemistry-related departments under the Faculty of Engineering, Kyoto University must attach their academic transcripts issued by the departments of the undergraduate schools from which they graduate.

- (4) Applicants who take the entrance examination for special admission of international students must receive instructions on the examination subjects from the chairperson of the department.
- (5) Selection of Course Program and Declaration of Research Area of Choice

\*The form must be downloaded from the website of the Graduate School of Engineering.

Applicants must refer to VII and enter the priority orders and areas of their choice in Selection of Course Program and Declaration of Research Area of Choice (Form MChem D-01) and submit it to A Cluster Office, Graduate Student Section (Department of Material Chemistry) by mail or hand no later than noon on Friday, January 31. For the details of researches, visit our website (<http://www.mc.t.kyoto-u.ac.jp/ja>).

Additional documents to be submitted to:

Kyoto University Katsura, Nishikyo-ku, Kyoto 615-8510  
A Cluster Office, Graduate Student Section (Department of Material Chemistry)  
Graduate School of Engineering, Kyoto University

## **VII. Selecting your course after enrollment**

Three course programs are provided for successful applicants after the enrollment in the Doctoral program. For those who passed the Department's examination, the following course programs are available.

- (a) Interdisciplinary Engineering Course of Integrated Master's-Doctoral Course Program  
(Materials Engineering and Chemistry)
- (b) Interdisciplinary Engineering Course of Integrated Master's-Doctoral Course Program  
(Integrated Medical Engineering)
- (c) Advanced Engineering Course of Integrated Master's-Doctoral Course Program  
(Department of Material Chemistry)

Successful applicants' course assignment is determined based on their preference and entrance examination results.

For the details, refer to "I. Preferred Research Area." For the details of course programs, refer to "XI. Educational Program (Interdisciplinary Engineering Course)" on and after page 25 of the Guidelines for Applicants and "VIII. Course Details" in the next section.

For (b), only students who have selected to study in the program at the time of Master's Course Program are eligible because the program is below for the "5-Year Course of Interdisciplinary Engineering Course" related to the "Program for Leading Graduate Schools."

To apply for (a), (b), and (c) of the Integrated Master's-Doctoral Course Program, applicants should contact the prospective supervisor(s) for the research areas of their choice.

If applicants are not sure who is their supervisor or have any other questions, they must contact the entrance examination staff specified in "IX. Other."

### **VIII. Course Details**

[Advanced Engineering Course]

With the rapid development of society, there is greater demand for the development of new substances and materials and the creation of novel functions. The advance of material science and technology supports our daily lives and industrial base today, and so the expectations for the roles that chemistry will play in the future are increasingly growing. Nowadays, chemistry is not merely a tool for creating new substances and materials, but it is rapidly developing into an academic discipline that studies the characteristics of atoms and molecules composing substances/materials and that investigates the properties or functions specific to the substances/materials.

The Department of Material Chemistry covers all the basic chemistry fields concerning physical chemistry, organic chemistry, inorganic chemistry, analytical chemistry, polymer chemistry, and bio-related chemistry, and provides education and research opportunities ranging from the fundamentals of chemistry to the latest applied research. The Doctoral program contributes to training chemists and chemical engineers who have the ability to positively open up new fields of material chemistry with their creative ideas and intelligent insights.

### **IX. Other**

- (1) Examination vouchers will be mailed to the applicant in early-February to the addresses written on the return envelope for examination voucher as mentioned in the Guidelines for Applicants.
- (2) Any applicant who forgets to bring the examination voucher on the examination day must promptly report it to the A Cluster Office, Graduate Student Section.
- (3) Contact for general inquires:  
Kyoto University Katsura, Nishikyo-ku, Kyoto 615-8510  
A Cluster Office, Graduate Student Section (Department of Material Chemistry),  
Graduate School of Engineering, Kyoto University  
Phone: +81 75-383-2076/2077  
E-mail: 090kakyomu@mail2.adm.kyoto-u.ac.jp  
Reference: <http://www.mc.t.kyoto-u.ac.jp/ja>

## (4) Research Descriptions

Area number	Chair and Laboratory/Details of Research [Department of Material Chemistry] <a href="http://www.mc.t.kyoto-u.ac.jp/ja">http://www.mc.t.kyoto-u.ac.jp/ja</a>	Applicable courses	
		Integrated Program (Interdisciplinary Engineering Course)	Integrated Program (Advanced Engineering Course)
1	<u>Functional Materials Design</u> (Design of functional materials, Inorganic synthetic chemistry, and solid-state chemistry) 1. Synthesis, structure analysis, and physical properties of new functional oxides 2. Understanding of structure–property relationships in layered compounds 3. Epitaxial growth and physical properties of complex oxide thin films 4. Optical properties of nanomaterials	Materials Engineering and Chemistry  Integrated Medical Engineering	According to the course program established by the Department of Material Chemistry
2	<u>Inorganic Material Chemistry</u> <u>Inorganic Structural Chemistry</u> (Inorganic structural chemistry, laser science, amorphous engineering, and functional nanomaterials) 1. Interaction between ultrashort pulse laser and materials 2. Nonequilibrium thermophysical properties of inorganic glasses 3. Synthesis and functionalization of nanomaterials 4. Low-temperature deformation of single-crystal semiconductors		
3	<u>Inorganic Material Chemistry</u> <u>Industrial Solid-State Chemistry</u> (Industrial solid-state chemistry, physical properties of inorganic solids, and functional inorganic materials) 1. Magnetism, magneto-optics, and spintronics of oxides 2. Development of new multiferroics 3. Plasmonics of metals and nonmetals with nanostructures 4. Photo-functions based on semiconductors and dielectrics with nanostructures		
4	<u>Organic Material Chemistry</u> <u>Organic Reaction Chemistry</u> (Organic reaction chemistry, stereochemistry, synthetic organic chemistry, organometallic chemistry, and chemistry of organic materials) 1. Development of organic functional materials 2. Highly selective organic synthesis reaction 3. New synthesis reaction using the characteristics of organic molecular catalysts 4. Development of organometallic compounds and its application to organic reaction		
5	<u>Organic Material Chemistry</u> <u>Organic Chemistry of Natural Products</u> (Organic chemistry of natural products, organic synthesis, organic metals, catalytic reaction, electron conjugated organic materials, and organic elemental chemistry) 1. Synthesis of functional materials utilizing the characteristics of hetero elements 2. Synthesis of new organometallic compounds and investigation of their functions 3. Synthesis of bioactive organic compounds 4. Catalytic reaction using transition metal complex		
6	<u>Organic Material Chemistry</u> <u>Analytical Chemistry of Materials</u> (Micro/nano-separation chemistry, analysis and characterization of materials, instrumental analysis chemistry, and high separation capacity analysis) 1. Improved performance and function of microscale liquid phase separations 2. Development of functional materials and their applications to microanalysis 3. Development of new analytical system with fine processing technology 4. Use of specific interaction in separation chemistry		
7	<u>Polymer Material Chemistry</u> <u>Polymer Physics and Function</u> (Polymer rheology, multi-phase polymer materials, physical properties of biomaterials, and tissue engineering) 1. Molecular structures and rheologic characteristics of polymer materials 2. Physics of polymer gels 3. Phase structures and physical properties of heterogeneous polymer systems 4. Mechanical characteristics of biologically-relevant substances and living tissues		
8	<u>Polymer Material Chemistry</u> <u>Biomaterial Chemistry</u> (Chemistry of polymer materials, chemistry of biomaterials, functional polymers, and biofunctional materials) 1. Molecular assembly with various morphology and characteristics 2. Peptide-based molecular device 3. Nanocarriers that modulate immune system 4. Glycotechnology		
9	<u>Nanomaterials</u> <u>Nanomaterials</u> (Nanosensing devices, electron transfer properties of nanostructures, electron transfer in solution and interfacial electron transfer, and spectroelectrochemical analysis) 1. Construction of nanosensing devices and evaluation of their functions 2. Analysis of electron transfer properties of conductive nanostructures 3. Investigation of correlation between electron transfer reaction in solution and electrode electron transfer reaction 4. Electrochemistry and spectrometric analysis of active species generated by organic electrode reaction		