

# Degree Programs in Pure and Applied Sciences

## Graduate School of Science and Technology

### Master's Program in Mathematics

| Field of Research | Faculty            | Detailed Description of Research Field   |
|-------------------|--------------------|--|
| Algebra           | SAGAKI Daisuke     | Combinatorial representation theory of Lie algebras and quantum groups.  |
|                   | MASUOKA Akira      | Hopf algebra theory, including its applications to quantum groups, and Galois theory of differential and difference equations. |
|                   | CARNAHAN Scott     | Moonshine, Automorphic forms, Algebraic geometry, Vertex algebras, Conformal fields  |
|                   | KANEKO Hajime      | Analytic number theory, uniform distribution theory and transcendental number theory   |
|                   | KIMURA Ken-ichiro  | Algebraic geometry and number theory: Study on K-groups and Chow groups.   |
|                   | MIHARA Tomoki      | p-adic number, global geometry, derived rigid geometry   |
| Geometry          | ONO Hajime         | Differential Geometry, in particular the existence problem of canonical Riemannian metrics. Kähler manifolds, Sasaki manifolds |
|                   | KAWAMURA Kazuhiro  | Geometric Topology, Geometry of Function spaces and Topological combinatorics.   |
|                   | ISHII Atsushi      | Low dimensional topology, Knot theory  |
|                   | TANGE Motoo        | Handle decomposition and differential structure of 4-manifold, Dehn surgery  |
|                   | NAGANO Koichi      | Global Riemannian geometry, Geometry of metric spaces  |
|                   | HIRAYAMA Michihiro | Dynamical systems, Ergodic theory  |
|                   | YAMAMOTO Hikaru    | Differential geometry. In particular, special geometry and geometric flow.   |
|                   | AIYAMA Reiko       | Differential geometry for surfaces and submanifolds.   |
| Analysis          | KAKEHI Tomoyuki    | Differential equations on symmetric spaces, Integral geometry.   |
|                   | TAKEYAMA Yoshihiro | Special functions and their applications to mathematical physics and number theory   |
|                   | HAMANA Yuji        | Theory of stochastic processes, Stochastic analysis  |

| Field of Research          | Faculty           | Detailed Description of Research Field  |
|----------------------------|-------------------|---|
|                            | FUKUSHIMA Ryoki   | Probability theory. In particular problems related to random media                                      |
|                            | KINOSHITA Tamotsu | Hyperbolic systems, Wavelet.  |
|                            | KUWABARA Toshiro  | Representation theory of noncommutative algebras and vertex algebras via microlocal analysis.           |
| Mathematics of Information | AOSHIMA Makoto    | Statistical science, Large complex data, High-dimensional statistical analysis, Asymptotic theory       |
|                            | YATA Kazuyoshi    | High-dimensional statistics, Asymptotic theory, Machine learning, Sequential analysis                   |
|                            | OIKAWA Issei      | Numerical analysis, Finite element methods, Discontinuous Galerkin methods                              |
|                            | SHIOYA Masahiro   | Axiomatic set theory, in particular, infinitary combinatorics and large cardinals.                      |
|                            | TERUI Akira       | Algorithms and applications in Computer Algebra, Symbolic Computation and Symbolic-Numeric Computation. |
|                            | TAKEUCHI Kota     | Mathematical logic, Model Theory, in particular Stability Theory.                                       |
|                            | [OHYAUCHI Nao]    | Study of statistical non-regular theory of estimation by Bayesian approach.                             |

(Note)

- ◆ Applicants cannot choose faculty members who are surrounded by “[ ]” as an academic supervisor. Instead, choose from other members in the same research field, and you can conduct the research theme with their cooperation.
- ◆ Applicants are requested to discuss their research plan, prior to application, with the faculty member by whom they would like to be supervised.

For inquiries about the entrance examination, please contact

Prof. Yuji Hamana, Chair, Master's Program in Mathematics

Email: hamana#@#math.tsukuba.ac.jp (Remove “#” )

Telephone: +81-29-853-4371

Website of Master's Program in Mathematics: <https://nc.math.tsukuba.ac.jp>

## Master's Program in Physics

| Field of Research |             | Faculty   | Detailed Description of Research Field  |
|-------------------|-------------|---|---|
| Particle physics  | Theory      | ISHIBASHI Nobuyuki<br>KURAMASHI Yoshinobu<br>ISHIKI Goro<br>ISHIZUKA Naruhito<br>YAMAZAKI Takeshi<br>[AKIYAMA Shinichiro]<br>[ASANO Yuhma]<br>[MOHRI Kenji]<br>[OHNO Hiroshi] | (1) Research on nonperturbative aspects of elementary particle physics by numerical analyses based on lattice field theory (QCD, physics beyond the standard model including string theory, tensor renormalization group)<br>(2) Theoretical studies related to string theory and quantum field theory (nonperturbative formulation of string theory such as string field theory and the matrix model, noncommutative geometry, gauge/gravity correspondence)   |
|                   | Experiment  | TAKEUCHI Yuji<br>[SATO Koji]<br>[IIDA Takashi]<br>[HIROSE Shigeki]  | (1) Studies of elementary particles at hadron-hadron colliding beam experiments (Higgs particle physics, top quark properties, electroweak interactions, bottom quark physics, quantum chromodynamics and strong interactions, and searches for new particles such as supersymmetry)<br>(2) Searches for neutrino decays and the determination of their masses using the cosmic neutrino background.<br>(3) Development of new particle detectors for the LHC accelerator luminosity upgrade, linear electron-positron colliders, and other future experiments. |
| Astrophysics      | Theory      | OHSUGA Ken<br>MORI Masao<br>YAJIMA Hidenobu<br>YOSHIKAWA Kohji<br>[WAGNER Alexander]<br>[FUKUSHIMA Hajime]  | (1) Formation of Cosmic Structure and Observational Cosmology<br>(2) Formation of the First Generation Objects<br>(3) Formation and Evolution of Galaxies<br>(4) Black Holes<br>(5) Evolution of Planetary Systems and Astrobiology<br>Theoretical researches on these issues by using simulations with supercomputers and by analytic methodology.   |
|                   | Observation | KUNO Nario<br>HASHIMOTO Takuya<br>[HONDA Shunsuke]  | Observational study of our Galaxy, galaxies, active galactic nuclei, distant universe, et al., and development of radio telescopes and detectors. Projects of submillimeter and terahertz telescopes which will be installed in the Antarctic plateau are advancing, in addition to observing with existing telescopes such as the Nobeyama 45-m telescope and ALMA.  |
| Nuclear physics   | Theory      | NAKATSUKASA Takashi<br>SHIMIZU Noritaka<br>SATO Shunsuke<br>HINOHARA Nobuo  | (1) Theoretical researches on quantum many-body systems with the strong interaction, such as microscopic structure of unstable nuclei and neutron stars, nuclear reaction for element   |

| Field of Research        |            | Faculty   | Detailed Description of Research Field  |
|--------------------------|------------|---|---|
|                          |            | [MIYAGI Takayuki]   | <p>synthesis in the universe, large-scale nuclear structure calculation for interdisciplinary applications, etc.</p> <p>(2) Computational approaches to interaction between ultra-short laser pulse and material.</p>   |
|                          | Experiment | OZAWA Akira<br>ESUMI Shinichi<br>SASA Kimikazu<br>CHUJO Tatsuya<br>[MORIGUCHI Tetsuaki]<br>[NONAKA Toshihiro]<br>[NIIDA Takafumi]<br>[PARK Jonghan]                 | <p>(1) Experimental Study of Nuclear physics using relativistic heavy ion collider (Quark Gluon Plasma, Big Bang Cosmology, Reaction mechanism of high energy nuclear collision)</p> <p>(2) Evolution of Nucleosynthesis using RI beam (Nucleosynthesis, Unstable nuclei, Precise mass spectroscopy of rare nuclei)</p> <p>(3) Accelerator Mass Spectrometry (AMS) of cosmogenic nuclides(Global environmental changes, Age dating, Cosmic-ray intensity variation and Ultrasensitive detection method for radionuclides), Environmental radiation and Radiation physics</p> <p>(4) R&amp;D of new experimental devices (Accelerator, detector, new application of accelerator beam)</p>  |
| Condensed matter physics | Theory     | OTANI Minoru<br>OKADA Susumu<br>TANIGUCHI Nobuhiko<br>MIZOGUCHI Tomonari<br>[YOSHIDA Kyo]<br>[MARUYAMA Mina]<br>[GAO Yanlin]<br>[HAGIWARA Satoshi]<br>[SONE Kazuki] | <p>(1) Computational material sciences (Otani, Okada, Maruyama, Gao, Hagiwara): Using the first principles techniques based on the quantum mechanics, we study physical and chemical properties of nanoscale materials, ranging from the semiconductor to biomaterials.</p> <p>(2) Quantum transport (Yoshida): Theory of quantum transport in nano-structures made of various semiconductors. Non-equilibrium dynamics and quantum coherence in compound quantum system and possible application to quantum computations.</p> <p>(3) Quantum theory of matter (T. Mizoguchi , K.Sone )<br/>           Theoretical/numerical studies of quantum phases of matter (theory of bulk-edge correspondence, graphene, quantum (spin) Hall systems, strongly correlated systems, exotic superconductors, quantum spins, Berry phases, topological insulators, etc.)</p> <p>(4) Nano Quantum Physics (Taniguchi): Quantum properties and quantum transport phenomena in semiconductor nanostructures; Quantum field theories of nonequilibrium steady states; Quantum field theories of low dimensional</p> |

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|-------------------|------------|---|
|                   | Experiment | <p>systems, random systems or chaotic systems.</p> <p>(1) Low temperature physics (Kanda, Morishita)<br/>Mesoscopic electron transport in nanoscale systems: quantum effects in graphene and other atomic layer 2D materials, observation and manipulation of quantum states in mesoscopic superconductors. Low dimensional quantum properties in quantum fluids and quantum solids (helium) which appear with structural control.</p> <p>(2) Energy materials science (Y. Moritomo, W. Kobayashi, H. Niwa)<br/>Research of the energy materials and devices, such as, tertiary battery (energy harvesting), secondary battery, perovskite solar cell, thermoelectrics, and so on with use of Synchrotron-radiation X-ray (SPring-8, PF) and nano probes (NIMS).</p> <p>(3) Structural Materials Science (Nishibori, Kasai):<br/>Structural materials science using advanced x-ray region photon sources. Ultra-high resolution charge density study; In-situ observation of nano-particle synthesis; structural studies of thermoelectrics, battery materials, molecular functional materials. International research collaboration using research unit project. Advanced Structural research using X-ray free electron laser.</p> <p>(4) Nanophotonics (Ikezawa, Kubo, Tomimoto):<br/>[Semiconductor Optics] We investigate optical properties, spin characteristics and quantum optics in low dimensional semiconductor nanostructures such as quantum wells, quantum dots and defects using various spectroscopy, including femto/pico-second laser spectroscopy.<br/>[Surface Dynamics] Studies on dynamics of charge carriers, collective excitations such as surface plasmons, and wave packets excited on solid surfaces, hetero-interfaces, and nanostructures. Developments of novel ultrafast time-resolved microscopy methods.</p> <p>(5) Optical nanoscience (Nomura): Studies on optical and spin properties of semiconductor nanostructures by advanced optical techniques. Studies on quantum spin systems in diamond NV centers, electron systems such as in heterostructures, and atomic layered compounds.</p> |

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|-------------------|------------|---|--|
| Biophysics        | Theory     | SHOJI Mitsuo<br>[HORI Yuta]<br>[OKAZAWA Kazuki]   | Simulation researches on biological macromolecules (proteins, nucleic acids and sugars) and supercomplexes. Development of computational methods to reveal the structure-function relationship, enzymatic catalytic reaction and origin of life.   |
| Plasma Physics    | Experiment | SAKAMOTO Mizuki<br>MINAMI Ryutaro<br>YOSHIKAWA Masayuki<br>[KOHAGURA Junko]<br>[HIRATA Mafumi]<br>[NUMAKURA Tomoharu]<br>[HWANGBO Dogyun]<br>[EMOTO Kazuma] | (1) Study on plasma transport and confinement by magnetic and electric fields, and divertor simulation study using a tandem mirror device.<br>(2) Study on plasma heating and electric field formation by using microwave and radio frequency wave, and control of heat and particle transport in core and boundary plasmas.<br>(3) Plasma diagnostics with X ray, infrared, microwave, particle beam, visible light, laser, etc. Using these diagnostics, especially, study on relation between plasma transport and instability and fluctuation.<br>(4) Theoretical analysis and computer simulation related to above experiments and its application to plasma thruster.<br>(5) Study on plasma-material interaction. |

【Cooperative Graduate School System】

| Field of Research                  | Faculty   | Detailed Description of Research Field  |
|------------------------------------|---|---|
| Advanced Interdisciplinary Physics | MARUYAMA Toshiki<br>(JAEA)<br>MIYAMOTO Yoshiyuki<br>(AIST)<br>NISHIMURA Shunji<br>(RIKEN) | Simulation researches on dynamics of quark and hadrons (Maruyama)<br>Condensed matter physics: Ultra-fast phenomena by electron excitations (Miyamoto)<br>Study of nuclear astrophysics using new accelerator and new experimental techniques (Nuclear Structure, Nuclear Cosmology, Neutron-Rich Nuclei) (Nishimura) |
| Nuclear Fusion and Plasma Physics  | SAKAMOTO Yoshiteru<br>NAKANO Tomohide<br>(QST)  | (1) Study on integrated scenario of a large nuclear fusion device.<br>(2) Study on core-boundary plasma physics for a large nuclear fusion device.<br>(3) Study on plasma control scenario for a nuclear fusion reactor.  |
| Frontier Materials Science         | YAMAMOTO Tsuyoshi<br>(NEC)<br>Work location is AIST                                       | Research on superconducting devices for quantum information processing application. Circuit-based quantum electronics is explored with technologies such as nano-fabrication and microwave engineering.   |

| Field of Research | Faculty                                      | Detailed Description of Research Field  |
|-------------------|--|---|
|                   | YUGE Ryota<br>(NEC)<br>Work location is AIST | Research on devices with carbon nanotubes and carbon nanobrushes. They contain the material preparation, characterization, and sensing and energy device applications.  |
|                   | SASAKI Ken-ichi<br>(NTT)                     | We study the electronic properties of graphene, graphite, and carbon nanotube using the method of condensed matter physics. We aim for theoretical proposal of new and versatile ideas.   |
|                   | SHINYA Akihiko<br>(NTT)                      | Research on ultra-compact and ultra-low power photonic devices and circuits, novel photonic phenomena in nanostructures.  |
|                   | OGURI Katsuya<br>(NTT)                       | Research on ultrafast optical physics, in particular, attosecond physics. We are investigating lightwave-matter interaction dynamics on extreme short time scale by developing various attosecond time-resolved spectroscopic techniques. |

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- ◆ Applicants cannot choose faculty members who are surrounded by “[ ]” as an academic supervisor. Instead, choose from other members in the same research field, and you can conduct the research theme with their cooperation.

(1) Please refer to the website below. Applicants should have a thorough discussion with a professor of their research field about your research plan two weeks before the examination.

Inquiries about the entrance examination should be sent to:

Prof. Akira Ozawa, Chair, Master's Program in Physics

Email: ozawa#@#tac.tsukuba.ac.jp (Remove “#” before sending an email)

Telephone: +81-29-853-4277

Website of Master's Program in Physics: <https://grad.physics.tsukuba.ac.jp/>

(2) Even though you passing the examination, the field of research of your choice might not the one you choose. A notification regarding the field of research you pass will be sent from Physics major followed by the university sending the letter of acceptance.

(Remarks) The faculty members in the list of the “Advanced Interdisciplinary Physics” research field by cooperative graduate school system offer their instruction by joint cooperative graduate school system. If you wish to apply for this method of instruction, contact the person above prior to the application.

(JAEA) = Japan Atomic Energy Agency

(AIST) = The National Institute of Advanced Industrial Science and Technology

(RIKEN) = Institute of Physical and Chemical Research

(QST) = National Institutes for Quantum and Radiological Science and Technology

(NEC) = NEC Corporation

(NTT) = NTT Basic Research Laboratories

## Master's Program in Chemistry

| Field of Research                  | Faculty  | Detailed Description of Research Field   |
|------------------------------------|--|--|
| Inorganic and Analytical Chemistry | KOJIMA Takahiko<br>[ISHIZUKA Tomoya]<br>[KOTANI Hiroaki]                         | Synthesis of transition-metal complexes and their reactivity in various redox and catalytic reactions; Development of photo- and redox-functionality of non-planar and fused porphyrins.   |
|                                    | NIHEI Masayuki<br>[SHIGA Takuya]<br>[MIHARA Nozomi]                              | Chemistry of multi-nuclear metal clusters with controlled structures and electronic states; Creation of ultra-small metal/metal oxide nano-particles.  |
|                                    | SAKAGUCHI Aya<br>[YAMASAKI Shinya]<br>[NAGATOMO Shigenori]<br>[MIYAGAWA Akihisa] | Studies on naturally-occurring/anthropogenic radionuclides in the environment; Study on radioactive wastes for their volume reduction. (Sakaguchi, Yamasaki)<br>Studies on physical and chemical processes of microdroplet, microparticle, and biopolymer using spectroscopic and electrochemical techniques. (Nagatomo, Miyagawa) |
| Physical Chemistry                 | ISHIBASHI Taka-aki<br>[SATO Tomoo]<br>[SHIBATA Keisei]                           | Studies on interfaces and condensed phases by linear and nonlinear molecular spectroscopy (Ishibashi, Shibata);<br>Studies on photofunctions and photochemical properties of newly fabricated molecular assemblies and inorganic particles in mesoscopic scale (Sato)  |
|                                    | ENAMI Shinichi<br>[NUMADATE Naoki]   | Atmospheric multiphase chemistry, interface chemistry and physics, biosurface chemistry, and molecular-level inhomogeneity on/in liquid phases.  |
|                                    | NISHIMURA Yoshinobu  | Synthesis of emissive compounds and kinetic analyses of formation and deactivation processes of the emissive state by TCSPC.   |
|                                    | MATSUI Toru  | Material design and bio-molecular modeling based on computational chemistry.   |
|                                    | MOMOTAKE Atsuya  | Development of useful molecules for photodynamic therapy and elucidation of reaction mechanisms, and development of nucleic acid adjuvants.  |
|                                    | YAMAMURA Yasuhisa  | Structure and property of soft molecular systems, and dynamics and phase transitions in them.  |
| Organic Chemistry                  | SASAMORI Takahiro<br>[ICHINOHE Masaaki]<br>[MASADA Koichiro]                     | Studies on synthesis of novel main-group-element compounds with unusual chemical bonds and elucidation of their chemical and physical properties. Creation of the novel species of main-group-element compounds in pursuit of unique organic reactions and functions utilizing main group elements.                                |
|                                    | FUCHIBE Kohei  | Development of synthetic reactions using organofluorine and organometallic compounds.  |



| Field of Research           | Faculty   | Detailed Description of Research Field  |
|-----------------------------|---|---|
|                             | YOSHIDA Masahito<br>[OHYOSHI Takayuki]                  | Bioorganic studies on bioactive natural products and related analogs based on isolation and total synthesis.  |
|                             | NAKAMURA Takashi  | Precise construction of functional molecules based on supramolecular chemistry, and exploration of their properties such as molecular recognition and selective reaction. Studies on supramolecular metal complexes utilizing organic ligands and metal ions. |
| Interdisciplinary Chemistry | IWASAKI Kenji<br>[HARADA Ayaka]<br>[KATO Kazashi]       | Study of proteins in soft-tissue sarcoma, chromatin remodeling factors and a photosensing flavoprotein. Structural biology and chemistry using single-particle cryo-EM and its development.   |
|                             | KUTSUMURA Noriki<br>[SAITOH Tsuyoshi]<br>[SUGAI Tomoya] | Design and synthesis of protein kinase ligands regulating sleep/wakefulness, Synthesis of biologically active nitrogen-containing heterocycles, Studies on chemoselective reaction useful for drug discovery.   |

**【Cooperative Graduate School System】**

| Field of Research                   | Faculty                        | Detailed Description of Research Field  |
|-------------------------------------|--------------------------------|---|
| High-pressure Organic Chemistry     | KAWANAMI Hajime<br>( A I S T ) | Studies in Organic Chemistry with High-pressure and Supercritical Fluids includes High-pressure Hydrogen Production, Carbon Dioxide Utilization Chemistry, Biomass Conversion, etc.   |
| Organic Electronics Chemistry       | YOSHIDA Yuji<br>( A I S T )    | Research on structural properties and photo-electrical properties of thin films based on polymers, molecular compounds and organic-inorganic hybrid materials, and chemistry on organic electronics such as organic photovoltaic cells (solar cells). |
| Nano-Carbon Materials Chemistry     | OKAZAKI Toshiya<br>( A I S T ) | Development of functional nano-carbon materials and characterizations of their physical properties.   |
| Photofunctional Materials Chemistry | NORIKANE Yasuo<br>( A I S T )  | Photofunctional organic molecules especially showing photo-induced solid-liquid phase transitions and lightdriven mechanical motion.  |
| Functional Polymer Gel Chemistry    | HARA Yusuke<br>( A I S T )     | Research and development of functional polymers and polymer gels for application to soft actuators, soft robots, micro fluidic devices.   |
| Organic Reaction Chemistry          | MINAMI Yasunori<br>( A I S T ) | Research and development of organic reactions and catalysts for precise organic transformations of stable chemicals including polymers  |

| Field of Research                  | Faculty                       | Detailed Description of Research Field  |
|------------------------------------|-------------------------------|---|
| Molecular Transformation Chemistry | UEDA Yoshihiro<br>( A I S T ) | Development of synthetic methods that enable naturally abundant resources to be transformed precisely and greenly into high-value substances. |

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- ◆ Applicants should discuss your research plan in advance with the desired supervisor.

Inquiries about the entrance examination should be sent to:

Prof. Takahiro Sasamori, Chair, Master's Program in Chemistry/

Prof. Aya Sakaguchi, Member of the Academic Committee Master's Program in Chemistry

Telephone: +81-29-853-4412•8789

Website of Master's Program in Chemistry: <https://program.chem.tsukuba.ac.jp/?lang=en>

(AIST) = The National Institute of Advanced Industrial Science and Technology

**Master's Program in Engineering Sciences  
Subprogram in Applied Physics**

| Field of Research               | Faculty            | Detailed Description of Research Field   |
|---------------------------------|--------------------|--|
| Optical and Quantum Engineering | HATTORI Toshiaki   | Generation and application of terahertz waves. Femtosecond nonlinear optical measurements.   |
|                                 | YASUNO Yoshiaki    | Fundamental, instrumentation, application research on optical tomographic imaging for medical and lifescience applications. It includes optical coherence tomography and quantitative three-dimensional functional microscopy. |
|                                 | HADA Masaki        | Femtosecond time-resolved electron diffraction measurements: filming “molecular movies” of photo-reactive or responsive materials, Terahertz-wave engineering.   |
|                                 | WATANABE Norio     | Development of X-ray imaging optics and its application to X-ray microtomography.  |
| Instrumentation Physics         | SHIRAKI Kentaro    | Technology of protein folding and application of biomaterials  |
|                                 | SEKIGUCHI Takashi  | Basics and application of scanning electron microscope (SEM). Electron and material interactions and physics of secondary and reflective electron. New measurement method by the electron beam.                                |
|                                 | SOHDA Yasunari     | Basic and application of scanning electron microscope (SEM). Electron optics and measurement of electron beam. Enhancement of SEM system and proposal new system.  |
|                                 | ITO Yoshikazu      | Synthesis, characterizations and fabrication of 3D Materials using graphene and two dimensional materials for developments of catalysts, device applications and energy harvesting devices with renewable energy sources       |
|                                 | KOBAYASHI Nobuhiko | Condensed matter theory. Computational materials science. Density functional theory for nonequilibrium systems. Theory of charge, heat and spin transport in nanoscale systems.  |
|                                 | TERADA Yasuhiko    | Development of new imaging methods based on NMR and MRI  |
|                                 | YAMADA Yoichi      | Surface and molecular sciences on the structure-property relationships of the self-organized organic semiconductors.   |

| Field of Research                   | Faculty          | Detailed Description of Research Field  |
|-------------------------------------|------------------|---|
|                                     | SEKIBA Daiichiro | Structure and electronic state study of hydrogen storage metals and metalloprotein by high energy ion beam and synchrotron radiation.   |
| Quantum Beam and Plasma Engineering | EZUMI Naomichi   | Study of plasma-gas interaction and plasma-wall interaction in boundary plasmas (edge-divertor plasmas) of magnetically confined nuclear fusion utilizing an open magnetic field structure of the largest tandem mirror plasma device GAMMA 10/PDX. To control the high heat flux boundary plasma, we are investigating the plasma behavior using advanced plasma measurement systems.                |
|                                     | TOMITA Shigeo    | Experimental studies on advanced atomic physics and atmospheric science using charged particle beams from accelerators  |
| Nano-Technology                     | HASE Muneaki     | Ultrafast laser spectroscopy on semiconductors and dielectric materials using femtosecond laser and application to optical device and controlling phase transitions   |
|                                     | UMEDA Takahide   | Electron-spin-resonance (ESR)-based characterization on nano-electronics devices and power-electronics devices  |
|                                     | TAKEUCHI Osamu   | Development of new microscopy techniques by combining nanometer-resolving scanning probe microscopy and optical measurement techniques, in order to reveal nanometer-scale optoelectronic processes in solar cells, light emitting diodes, and spintronics devices and to improve their device performance  |
|                                     | MAKIMURA Tetsuya | Nano- and Micro-machining and materials synthesis using laser produced plasma EUV light and laser light.  |
|                                     | YOSHIDA Shoji    | Our research target is to understand and develop nanoscale science and technologies of such as surface science, molecular physics, and new functional materials and devices. To realize these studies, we develop new microscopy techniques based on scanning probe microscopy and advanced laser technologies, which, for example, enable ultimate spatial and temporal resolutions, simultaneously. |
|                                     | OIGAWA Haruhiro  | Experimental study on nano physics and spectroscopy   |
|                                     | ARASHIDA Yusuke  | Optical control of electrons in solids and molecules in femtosecond temporal regime and Developing atomic scale imaging of the ultrafast phenomena.   |

| Field of Research                                      | Faculty                | Detailed Description of Research Field   |
|--|------------------------|--|
| Semiconductor Electronics<br>(Power Electronics)       | UEDONO Akira           | Study of defects in electronic materials using positron (antiparticle of electron) and developments of positron annihilation spectroscopy  |
|  | SUEMASU Takashi        | High-efficiency thin-film solar cells, thermoelectric devices, and spintronics materials using safe, stable, and abundant elements   |
|  | HASUNUMA Ryu           | Development of highly reliable gate dielectric films on Si and SiC substrates.   |
|  | TOKO Kaoru             | Research on materials and processes for highly functional thin films for flexible energy devices   |
|  | OKUMURA Hironori       | Crystal growth of wide bandgap semiconductors and development of their optical and electrical devices  |
|  | SELVAKUMAR Sellayan    | Defect studies on Fe based alloys and nanostructured materials by positron annihilation spectroscopy.  |
| Optoelectronics and Spintronics<br>(Power Electronics) | OHNO Yuzo              | Research on electronic, optical, and spin properties of semiconductor nanostructures, and spin injection and control which are the basis of spin lasers for ultra-high-speed and low-power consumption technologies        |
|  | SAKURAI Takeaki        | Development of highly efficient organic and inorganic thin-film solar cells. Characterization of defects in power semiconductor devices.   |
|  | YANAGIHARA Hideto      | Thin film growth of advanced magnetic oxides for spintronics devices   |
|  | ISLAM Muhammad Monirul | Growth and characterization of thin-film semiconductors for application in energy devices, such as solar cells and photocatalyst. Study of nanostructured semiconductors for battery application.                          |
|  | SHARMIN Sonia          | Using machine learning to analyze light emission spectra during sputtering   |
|  | TRAORE Aboulaye        | Ultra-wide bandgap semiconductors electron devices: development of device technologies for power-electronics and quantum sensing, investigation and modelling of electron transport mechanisms, defects characterizations. |
| Power Electronics                                      | IWAMURO Noriyuki       | Research on improvement of power semiconductor devices characteristics for achieving a low loss and high withstand capability  |
|  | ISOBE Takanori         | Study on circuit topologies and control for efficiency and power density improvement in power converters, and its emerging applications  |

| Field of Research | Faculty      | Detailed Description of Research Field   |
|-------------------|--------------|--|
|                   | YANO Hiroshi | Research on ultra-low-loss SiC power semiconductor devices, particularly improvement in SiC-MOS device performance and understanding of its interface physics, toward power electronics innovations. |

**(Materials Science and Engineering Class)**

Materials Science and Engineering Class is designed as a Master's course jointly operated by National Institute for Materials Science and Degree Programs in Pure and Applied Sciences, corresponding to Doctoral Program in Engineering Sciences, Subprogram in Materials Science and Engineering.

For details regarding this class, see here: <https://www.nims.go.jp/tsukuba/en/>

| Field of Research                              | Faculty            | Detailed Description of Research Field   |
|--|--------------------|--|
| Optoelectronic<br>Nanomaterials<br>Engineering | MITANI Seiji       | Development of magnetic materials and nanostructures by atomic scale control based on state-of-the-art thin film growth techniques. Searching and understanding new functionalities in spin transport and their application to spintronic devices.   |
|  | TAKANO Yoshihiko   | We are focusing on the physical properties of high-Tc superconductor, diamond superconductor, Fe-based superconductor and carbon nanotube. Development of novel devices, including optical and field effect devices, using superconductors and nano-technologies are targets.  |
|  | FUKATA Naoki       | The basic and applied research of next generation semiconductor transistor materials and new environment and energy related materials, which are characterized by high speed and low power consumption by compounding semiconductor nanomaterials of different dimensions and material types, is comprehensively carried out.  |
|  | YAMAGUCHI Takahide | Research on fundamental properties and device applications of diamond as an electronic material for power electronics, quantum information processing, and sensing. Development of quantum devices based on heterostructures consisting of diamond and two-dimensional materials such as graphene and h-BN.  |
|  | YOSHIKAWA Genki    | Research and development of olfactory sensors, the last frontier of the five senses. Based on various basic sciences such as structural mechanics, materials science, fluid mechanics, system engineering, and informatics, we will conduct comprehensive research and development of novel hardware and software with unprecedented performance, aiming for social implementation through industry-academia-government collaboration. |

| Field of Research | Faculty       | Detailed Description of Research Field  |
|-------------------|---------------|---|
|                   | ISHII Satoshi | Studies on developing novel photonic nanostructures for extraordinary optical properties and photoelectric/photothermal conversions. Includes both numerical and experimental works to develop, for examples, optical metamaterials and photonic nanostructures to harvest sunlight as well as solar heat.  |
|                   | SAKURABA Yuya | Focusing on special transport and thermoelectric effects derived from magnetism and spin, we studied new magnetic thin film materials and multilayer nanostructures. In addition to the fundamental research, we are also conducting research for practical devices such as next-generation data storage, ultra-sensitive magnetic sensors, and novel thermoelectric power generation applications. |

**【Cooperative Graduate School System】**

| Field of Research               | Faculty                 | Detailed Description of Research Field  |
|---------------------------------|-------------------------|---|
| Semiconductor Electronics       | MAKINO Toshiharu (AIST) | Diamond growth, and electronic device fabrication using unique properties.  |
| Optoelectronics and Spintronics | YUASA Shinji (AIST)     | Research and development of magnetic tunnel junctions, magnetoresistive random access memory MRAM and other spintronic devices.   |
| Surface Science                 | MIYAKE Koji (AIST)      | Surface functionalization by nano-/micro-structures and surface modifications.  |
| Power Electronics               | KOJIMA Kazutoshi (AIST) | Research and development on wide gap semiconductor epitaxial growth technique such as SiC and its characterization. Development of power device with new structure by using epitaxial growth technique. |

(Note)

- ◆ Applicants should have a thorough discussion with a professor of their research field about your research plan in advance.

Inquiries about the entrance examination should be sent to:

Prof. SUEMASU TAKASHI, Chair, Subprogram in Applied Physics

Email: suemasu.takashi.gu#@#u.tsukuba.ac.jp (Remove “#” before sending an email)

Telephone: +81-29-853-4966

For more information, please refer to the following websites:

Website of the Degree Programs in Pure and Applied Sciences: <http://www.pas.tsukuba.ac.jp/>

Website of Master’s Program in Engineering Sciences Subprogram in Applied Physics:

<https://applphys.bk.tsukuba.ac.jp/>

(AIST) = The National Institute of Advanced Industrial Science and Technology



**Master's Program in Engineering Sciences  
Subprogram in Materials Science**

| Field of Research              | Faculty            | Detailed Description of Research Field   |
|--------------------------------|--------------------|--|
| Quantum Physics of Solid State | KURODA Shinji      | Experimental studies on spin-related phenomena in the solid state. We develop novel materials exhibiting spin properties, such as magnetic semiconductors, topological insulators and their nanostructures, and clarify the spin-related properties aiming at the application to spin-based electronic devices |
|                                | MATSUISHI Kiyoto   | Study on optical properties and high-pressure physics of nanostructured semiconductors, such as quantum dots, organic-inorganic complexes, nano-carbon hybrids, and perovskites for search of new optically-functionalized materials.  |
|                                | MARUMOTO Kazuhiro  | Development and characterization of semiconductor materials, and their application to semiconductor devices such as solar cells, light-emitting devices, transistors, etc. using functional materials such as organic materials, perovskite materials, low-dimensional materials, etc.                         |
|                                | FUJIOKA Jun        | Research on electronic, optical and thermal property in strongly correlated electron material and topological quantum material. Searching new quantum phenomena and functions by using state-of-the-art material synthesis technique, spectroscopy and fundamental characterization.                           |
|                                | KASHIWAGI Takanari | Development of terahertz-waves emitters, detectors and applications based on single crystals of high temperature superconductors. Study of material characteristics of single crystals of high-temperature superconductors.  |
|                                | KANAZAWA Ken       | We focus on magnetic semiconductors as promising materials for spintronic devices. To realize novel semiconductors with room-temperature ferromagnetism, we fabricate samples by precise crystal growth methods such as molecular beam epitaxy.  |
|                                | MORI Tatsuya       | Fundamental research and application development on universal excitations appearing in disordered systems. We aim to understand the dynamics of glasses and proteins using terahertz spectroscopy and molecular dynamics simulation, and to develop novel applications of terahertz light.                     |

| Field of Research                 | Faculty           | Detailed Description of Research Field   |
|-----------------------------------|-------------------|--|
| Theoretical Quantum Physics       | KOIZUMI Hiroyasu  | Theoretical study of superconductivity in strongly-correlated materials and topological materials, and their application to fault-tolerant quantum computers.  |
|                                   | SUZUKI Shugo      | First-principles study of structural and electronic properties of materials  |
|                                   | TONG Xiao-Min     | Understand dynamical processes of atoms, molecules and solids in an ultrashort intense laser field and search an effective way to control the processes with intense laser in femtosecond domain by first principles simulations.  |
|                                   | MAESHIMA Nobuya   | Theoretical study of photo-induced phenomena in strongly correlated electron systems and topological materials   |
| Materials Physics and Engineering | KIZUKA Tokushi    | Development of heat resistance materials and carbon fiber-reinforced composites for aircrafts and jet engines, nanowires, nanocontacts devices, and mechanical and friction nanostructures for nanodevices by electron microscopy. |
|                                   | KIM Hee Young     | Development and characterization of novel functional alloys and biomaterials including biomedical superelastic alloy, high temperature shape memory alloy, high entropy alloy and gum metal  |
|                                   | TOKORO Hiroko     | Development of novel materials with advanced light-responsive functionalities, accompanying changes of optical, magnetic, and electric properties. Metal complexes and metal oxides are the main target materials                  |
|                                   | KOYANO Tamotsu    | Research on phase transformation and microstructure of high nitrogen steel. Our goal is production of the low alloy steel for automobile and molds without comprising rare metals  |
|                                   | SUZUKI Yoshikazu  | Development of new inorganic materials for energy and environmental applications such as solar cells and environmental purification filters  |
|                                   | TANIMOTO Hisanori | Research on characteristic properties and application of nanostructured materials (amorphous alloys and metallic nanoparticles etc.) and high-entropy alloys.  |
|                                   | TAKAHASHI Miwako  | Phase transitions and structural fluctuations in magnetic alloys and compounds studied by diffraction techniques using quantum beams (neutron beams and X-rays)  |

| Field of Research                     | Faculty           | Detailed Description of Research Field  |
|---------------------------------------|-------------------|---|
| Materials Chemistry and Biotechnology | KANBARA Takaki    | Development and characterization of novel functional polymers and organometallic compounds directed toward organic devices and catalysts  |
|                                       | KONDO Takahiro    | Creating new materials contributing to the carbon neutrality, surface physics and chemistry at atomic scale, surface reaction dynamics, and creating new materials composed of boron.     |
|                                       | TSUJIMURA Seiya   | Electrochemistry of redox enzymes and its application to biosensors and biofuel cells   |
|                                       | YAMAMOTO Yohei    | Self-assembly of $\pi$ -conjugated molecules, polymers, and biomolecules to construct electronic, optical, and energy conversion devices.   |
|                                       | OISHI Motoi       | Development and design of novel point of care testing (POCT) devices and nano-machines based on DNA nano-system.  |
|                                       | KUWABARA Junpei   | Development of new molecular catalysts, facile synthetic methodology for conjugated molecules, and luminescent metal complexes.   |
|                                       | GOTO Hiromasa     | Synthesis and properties of low-molecular mass compounds and polymeric materials having magnetism, electrical conductivity, photo-isomerization, optical rotation, and circular dichroism |
|                                       | YAMAGISHI Hiroshi | We develop novel molecular crystals with distinct structural flexibility by assembling the constituent molecules via extremely weak intermolecular interactions in a programmable manner  |

**(Materials Science and Engineering Class)**

Materials Science and Engineering Class is designed as a Master's course jointly operated by National Institute for Materials Science and Degree Programs in Pure and Applied Sciences, corresponding to Doctoral Program in Engineering Sciences, Subprogram in Materials Science and Engineering.

For details regarding this class, see here: <https://www.nims.go.jp/tsukuba/en/>

| Field of Research          | Faculty         | Detailed Description of Research Field  |
|----------------------------|-----------------|---|
| Nanostructural Engineering | EBARA Mitsuhiro | Our research group is interested in developing smart biotechnologies using stimuli-responsive polymers. These smart biomaterials are designed to act as an "on-off" switch for drug delivery technologies, gene therapy, affinity separations, chromatography, diagnostics. |

| Field of Research | Faculty           | Detailed Description of Research Field   |
|-------------------|-------------------|--|
|                   | KAWAKAMI Kohsaku  | Development of pharmaceutical/cosmetic materials are of our research interests, where self-assembly phenomena of organic molecules are utilized to add novel functions. Also focused is regulation of non-equilibrium behaviors of soft materials, which is important for maximizing function of drug products.  |
|                   | SHIBATA Akinobu   | Main our research target is structural metallic materials (particularly, steel). We are investigating microstructure evolution by phase transformation, relationship between deformation / fracture behavior (mainly brittle fracture, such as hydrogen embrittlement) and microstructure. We try to propose novel alloy design and microstructure design concepts for developing advanced steels from theoretical background. |
|                   | TAGUCHI Tetsushi  | Basic research on polymer-based medical materials for minimally invasive treatment and tissue regeneration. By synthesizing polymeric materials that change from sol to gel in the in vivo environment and combining these materials with cells and drugs, we will develop tissue adhesive materials, anti-adhesive materials, injectable materials for localized cancer treatment, and other applications.                    |
|                   | TAKEUCHI Masayuki | Creation of new organic nanochemistry thorough the design, synthesis, and characterization of organic, macromolecular, and supramolecular materials with photo- and electro-active components, chemosensing functions, dynamic mechanical characters.  |
|                   | CHEN Guoping      | Preparation of biocompatible and biofunctional polymer biomaterials with controlled porous and surface structures using biodegradable polymers and bioactive factors, and their application for tissue engineering.  |
|                   | NAITO Masanobu    | We aim to research and develop functional materials that contribute to the circular economy, such as self-healing materials, adhesives, coatings, and superhydrophobic materials, through data-driven research using state-of-the-art autonomous smart lab systems and materials informatics.  |

| Field of Research | Faculty          | Detailed Description of Research Field   |
|-------------------|------------------|--|
|                   | MORI Takao       | We focus on developing highly functional energy environment materials, such as, thermoelectric and battery materials, through atomic network control, synthesis of new materials, nano/microstructure control of materials with strong structure-property relationships from their topology.   |
|                   | HASHIMOTO Ayako  | Development and applications of transmission electron microscopy techniques and systems. We especially focus on in-situ observations of environmental and energy materials such as photovoltaic materials, fuel cells, rechargeable batteries and so on.   |
|                   | WATANABE Ikumu   | We have developed a computer aided engineering framework to accelerate material research and development, based on multi-scale and multi-discipline modeling to characterize material behaviors and properties. We focus on especially structural materials for automotive and aviation industries.  |
|                   | KAWAI Shigeki    | Single molecular chemistry with high-resolution atomic force microscopy/scanning tunneling microscopy. Development of local probe chemistry. Functionalized nano-carbon materials synthesized by on-surface chemical reaction.   |
|                   | SODEYAMA Keitaro | The working mechanism of energy-related materials such as lithium-ion batteries will be clarified by first-principles molecular dynamics simulations using a supercomputer. We also use the machine learning techniques to find new feasible materials with experimentalists.  |
|                   | SAKAUSHI Ken     | We conduct our research to solve modern energy issues through unveiling basic principles and synthesis of materials of electrochemistry towards fuel-cells and rechargeable batteries. We put special emphasis on researches in collaboration with experiments, theoretical calculations, and data science, focusing on the following two points: (1) uncovering reaction mechanisms by using model electrodes, and (2) design and synthesis of novel electrode materials. |

【Cooperative Graduate School System】

| Field of Research                           | Faculty                 | Detailed Description of Research Field  |
|---|-------------------------|---|
| Materials<br>Chemistry and<br>Biotechnology | CHOI Jun-Chul<br>(AIST) | We aim at the development of high efficiency catalyst for green synthetic processes and material design of highly dispersed metal catalyst.                                     |
|   | KURITA Ryoji<br>(AIST)  | We conduct R&D from basic research to device development as regard a novel biomolecule analysis, and contribute to the development of next-generation medical and life science. |

(Note)

- ◆ Applicants should have a thorough discussion with a professor of their research field about your research plan in advance.

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Related Websites ( <http://www.pas.tsukuba.ac.jp/>  
<http://www.ims.tsukuba.ac.jp/>  
<http://www.tsukuba.ac.jp/> )

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## Master's Program in Materials Innovation

| Field of Research            | Faculty           | Detailed Description of Research Field  |
|------------------------------|-------------------|---|
| Energy Materials Engineering | SUEMASU Takashi   | High-efficiency thin-film solar cells, thermoelectric devices, and spintronics materials using safe, stable, and abundant elements.   |
|                              | NISHIBORI Eiji    | Structural Materials Science:<br>Structural materials science using advanced x-ray region photon sources. Ultra-high resolution charge density study; In-situ observation of nano-particle synthesis; structural studies of thermoelectrics, battery materials, molecular functional materials. International research collaboration using research unit project. |
|                              | MORITOMO Yutaka   | Energy materials science:<br>Research of the energy materials and devices, such as, sodium-ion secondary battery, perovskite solar cell, thermoelectrics, catalyst, superconductor, and so on with use of Synchrotron-radiation X-ray (SPring-8, PF) and nano probes (NIMS), and so on.   |
|                              | SAKURAI Takeaki   | Development of highly efficient organic and inorganic thin-film solar cells. Characterization of defects in power semiconductor devices.  |
|                              | TOKORO Hiroko     | Development of novel materials with advanced light-responsive functionalities, accompanying changes of optical, magnetic, and electric properties. Metal complexes and metal oxides are the main target materials   |
|                              | SUZUKI Yoshikazu  | Development of new inorganic materials for energy and environmental applications such as solar cells and environmental purification filters   |
|                              | HADA Masaki       | Femtosecond time-resolved electron diffraction measurements: filming “molecular movies” of photo reactive or responsive materials, Terahertz-wave engineering.  |
|                              | MORI Takao (NIMS) | We focus on developing highly functional energy environment materials, such as, thermoelectric and battery materials, through atomic network control, synthesis of new materials, nano/microstructure control of materials with strong structure-property relationships from their topology.  |

| Field of Research                 | Faculty                           | Detailed Description of Research Field  |
|-----------------------------------|-----------------------------------|---|
|                                   | INOUE Isao<br>(AIST)              | Ultra-low-power IT is an urgent necessity, and we challenge the problem by mimicking the brain. Artificial neurons/synapses and their circuits are in development with new materials and physics POV.   |
|                                   | YU Denis Y. W.<br>(NIMS)          | Synthesis and characterizations of battery materials: study the effect of surface chemistry and structure on electrochemical performance, long-term stability and safety  |
|                                   | TAKAHASHI Yukiko<br>(NIMS)        | Research on functional magnetic thin films for magnetic storage and permanent magnet etc. To improve the magnetic properties, we focuses on the relationship of microstructure, magnetic properties and magnetization dynamics.   |
|                                   | SEPEHRI AMIN<br>Hossein<br>(NIMS) | Studies on high-performance magnetic materials for green energy conversions and data storage applications using a combinatorial research approach, i. e. multi-scale microstructure characterizations, micromagnetic simulations, data science, and materials processing. |
| Environment-friendly<br>Materials | YAMAMOTO Yohei                    | Self-assembly of $\pi$ -conjugated molecules, polymers, and biomolecules to construct electronic, optical, and energy conversion devices.   |
|                                   | SAKAGUCHI Aya                     | Environmental dynamics using stable/radio- isotopic composition and chemical speciation analyses.   |
|                                   | SHIRAKI Kentaro                   | Technology of protein folding and application of biomaterials   |
|                                   | KONDO Takahiro                    | Formation and application of new two-dimensional material of boron, development of a substitute material of Pt at the Fuel Cell electrode using nitrogen-doped carbon, and reaction dynamics at surface based on the fine experimental measurements.                      |
|                                   | SASAMORI Takahiro                 | Main group element chemistry. Creation of novel compounds with unique chemical bondings by utilizing element properties. Development of unique organic reactions with main group element compounds.   |
|                                   | TSUJIMURA Seiya                   | Electrochemistry of redox enzymes and its application to biosensors and biofuel cells   |
|                                   | OISHI Motoi                       | Development and design of novel point of care testing (POCT) devices and nano-machines based on DNA nano-system.  |



| Field of Research | Faculty                     | Detailed Description of Research Field   |
|-------------------|-----------------------------|--|
|                   | KUWABARA Junpei             | Development of new molecular catalysts, facile synthetic methodology for conjugated molecules, and luminescent metal complexes.  |
|                   | YAMAGISHI Hiroshi           | We develop novel molecular crystals with distinct structural flexibility by assembling the constituent molecules via extremely weak intermolecular interactions in a programmable manner.  |
|                   | NAKAMURA Takashi            | Precise construction of functional molecules based on supramolecular chemistry, and exploration of their properties such as molecular recognition and selective reaction. Studies on supramolecular metal complexes utilizing organic ligands and metal ions.  |
|                   | KUSHIDA Soh                 | We aim to achieve light-matter strong coupling systems by self-assembly of organic molecules for the novel quantum device applications.  |
|                   | TAKEUCHI Masayuki<br>(NIMS) | Creation of new organic nanochemistry through the design, synthesis, and characterization of organic, macromolecular, and supramolecular materials with photo- and electro-active components, chemosensing functions, dynamic mechanical characters.   |
|                   | NAITO Masanobu<br>(NIMS)    | Development of functional polymer materials using machine learning and smart labs. In particular, we will create innovative composite materials that support people's safety and security through the development of bonding and coating materials with different materials, antibacterial, antiviral, and superhydrophobic materials. |
|                   | HIMEDA Yuichiro<br>(AIST)   | Design and development of organometallic catalysts for carbon dioxide conversion and hydrogen storage. Methanol synthesis at low temperature from carbon dioxide. Hydrogen production from formic acid.  |
|                   | AOKI Hiroshi<br>(AIST)      | Novel biomarker sensing contributing to environmental and biomedical fields, focusing on functional molecules responsive to molecular recognition and their applications to biomarker detection devices.   |
|                   | NORIKANE Yasuo<br>(AIST)    | Photofunctional organic molecules especially showing photo-induced solid-liquid phase transitions and lightdriven mechanical motion.   |

| Field of Research    | Faculty                      | Detailed Description of Research Field  |
|----------------------|------------------------------|---|
|                      | Lok Kumar Shrestha<br>(NIMS) | Fabrication of fullerene-based new functional nanomaterials using nanoarchitectonics concept. We produce ultra-high surface area nanoporous fullerene crystals, and convert them into hierarchically porous carbon materials by high temperature heat treatment for the high-performance supercapacitor and vapor sensing applications. |
|                      | KATSURA Yukari<br>(NIMS)     | Design of inorganic functional materials database for experimental materials informatics. Searches for new inorganic crystals and new thermoelectric materials by data science, first-principles calculation and experiments.   |
|                      | TANG Daiming<br>(NIMS)       | Development of carbon nanotube (CNT) molecular junction based ultimate nano-transistors and nano-electromechanical systems (NEMS). Atomic characterization and properties measurement of nanostructures and nanodevices by advanced in situ transmission electron microscopy (TEM).   |
|                      | WEI Qingshuo<br>(AIST)       | We aim to understand the doping mechanisms of organic semiconductors, develop new materials and design devices based on them, and to commercialize organic thermoelectric devices and thermoelectrochemical cells.  |
| Electronic Materials | HASE Muneaki                 | Ultrafast laser spectroscopy on semiconductors and dielectric materials using femtosecond laser and application to optical device and controlling phase transitions   |
|                      | YANAGIHARA Hideto            | Thin film growth of advanced magnetic oxides for spintronics devices  |
|                      | OKADA Susumu                 | Using the first-principles techniques based on the quantum mechanics, we study physical and chemical properties of nanoscale materials, ranging from the semiconductor to biomaterials.   |
|                      | OHNO Yuzo                    | Studies of electronic, optical, and spin properties of semiconductor nanostructures, and spin coherence for quantum information and low-power devices.  |
|                      | MARUMOTO Kazuhiro            | Development and characterization of semiconductor materials, and their application to semiconductor devices such as solar cell, light-emitting diodes, transistors, etc. using functional materials such as organic materials, perovskites, low-dimensional materials, etc.   |

| Field of Research | Faculty                    | Detailed Description of Research Field   |
|-------------------|----------------------------|--|
|                   | TAKEUCHI Osamu             | Development of new microscopy techniques by combining nanometer-resolving scanning probe microscopy and optical measurement techniques, in order to reveal nanometer-scale optoelectronic processes in solar cells, light emitting diodes, and spintronics devices and to improve their device performance   |
|                   | TONG Xiao-Min              | Understand dynamical processes of atoms, molecules and solids in an ultrashort intense laser field and search an effective way to control the processes with intense laser in femtosecond domain by first principles simulations.  |
|                   | FUJIOKA Jun                | Research on electronic, optical and thermal property in strongly correlated electron material and topological quantum material. Searching new quantum phenomena and functions by using state-of-the-art material synthesis technique, spectroscopy and fundamental characterization.                         |
|                   | YAMADA Yoichi              | Basic researches on next-generation materials in organic and hydrogen nanotechnology. Nano-scale engineering utilizing self-organization phenomena.  |
|                   | GAO Yanlin                 | Electronic structure theory. Computational material science. To reveal and predict the electronic and geometric structures of new carbon related materials based on the quantum theoretical approaches. Theoretical prediction of electronic properties of nano-scale structures on surfaces and interfaces. |
|                   | YUASA Shinji<br>(AIST)     | Research and development of magnetic tunnel junctions, magnetoresistive random access memory MRAM and other spintronic devices.  |
|                   | TAKANO Yoshihiko<br>(NIMS) | We are focusing on the physical properties of high-Tc superconductor, diamond superconductor, Fe-based superconductor and carbon nanotube. Development of novel devices, including optical and field effect devices, using superconductors and nano-technologies are targets.                                |
|                   | MITANI Seiji<br>(NIMS)     | Development of magnetic materials and nanostructures by Atomic scale control based on state-of-the-art thin film growth techniques. Searching and understanding new functionalities in spin transport and their application to Spintronic devices.   |

| Field of Research                              | Faculty                  | Detailed Description of Research Field   |
|--|--------------------------|--|
|  | SANG Liwen<br>(NIMS)     | Development on the optical, electronic and mechanical devices based on polarization field in III-V nitride semiconductors. Physical properties engineering at semiconductor nanointerfaces.  |
|  | HIRANO Atsushi<br>(AIST) | We explore the interaction mechanisms between nanomaterials and biomolecules to understand the biological behavior of nanoparticles and develop novel composites. While our primary focus lies on nanocarbons and proteins as targets, we also extend our exploration to a diverse range of materials. |
| Synchrotron-Radiation<br>Materials Engineering | AMEMIYA Kenta<br>(KEK)   | Elucidation of the function expression mechanism by operando observation of surface and interface using quantum beams.   |
|  | KUMAI Reiji<br>(KEK)     | Study using quantum beams such as synchrotron radiation to reveal the origin of macroscopic physical properties from the microstructure inside materials in condensed matter.  |
|  | YOKOO Tetsuya<br>(KEK)   | The dynamics in functional materials, in particular high-Tc superconductors and quantum spin systems are the target of research. Neutron scattering technique is utilized as a probe, also physical thermodynamic quantities will be measured to elucidate the mechanism in materials.                 |

(Note)

- ◆ Applicants should have a thorough discussion with a professor of their research field about your research plan in advance.

Inquiries about the entrance examination should be sent to:

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(NIMS) = The National Institute for Materials Science

(KEK) = High Energy Accelerator Research Organization