

NAGASAKI UNIVERSITY GRADUATE SCHOOL OF ENGINEERING

Doctoral Degree (5-Year Program)

**Department of
Advanced Technology and Science
for Sustainable Development**



**Department of Advanced Technology and
Science for Sustainable Development**

This major aims to create technologies that support the sustainable development of society.

Specifically, this program aims to cultivate leading researchers in the fields of next generation energy systems and advanced functional materials.

During the program the opportunity to perform research abroad will be provided.

Special Conversation

Goals of the Department of Advanced Technology and Science for Sustainable Development

Hiroshi Fujiyama × Nicholas Kirkland



| Prof. Hiroshi Fujiyama |

Head of the Department of Advanced Technology and Science for Sustainable Development (Common Name: Creative Science for Green System), Graduate School of Engineering, Doctoral Degree (5-Year Program), Nagasaki University. Doctor of Engineering (Kyushu University) in 1981, Research Associate, Kyushu University in 1977, Associate Professor, Nagasaki University in 1982, Professor, Nagasaki University in 1987. Chairman of Plasma Electronics Division in Japanese Society of Applied Physics in 2000-2002, Director of Japanese Society of Applied Physics in 2006-2008. Vice Chair of Asian Joint Committee on Plasma Surface Engineering in 2009-2011. Executive Committee Member of Gaseous Electronics Conference of American Physical Society in 2009-2011. Prize by Minister of Science & Technology, Prize on Plasma Materials Science in Japan Society for the Promotion of Science, Fellow of Japanese Society of Applied Physics, The Japan Society of Plasma Science and Nuclear Fusion Research (JSPF) Award for Notable Contribution. Interests are River Fishing, Golfing, Skiing and Jogging.

| Dr. Nicholas T. Kirkland, Assistant Professor |

An Associate Professor with the Department of Advanced Technology and Science for Sustainable Development since January 2012, worked as a Research Associate at Monash University in Melbourne, Australia (2011), Completed a PhD in Biomedical Engineering at the University of Canterbury, Christchurch, New Zealand (2011), Obtained a Masters in Design and Manufacturing Engineering from Durham University in England (2007). Completed the International Baccalaureate at the International School of Tanganyika, Tanzania (2003) Specialized in Electrochemical, Bio/Energy materials. Hobbies include world travel, eating new foods, tennis, fishing and beer.

Fujiyama(F): Welcome to Nagasaki University, Nick. We will be creating our new research and educational system in the department together. What is your impression of Nagasaki?

Kirkland(K): Thank you for the warm welcome Fujiyama sensei. I'm very excited to now be living in a place as beautiful as Nagasaki, and am ready to get to know Japanese culture and people.

I was lucky enough to have visited Japan 3 times before, and when I came to Nagasaki for my interview I explored every day. Before I came, I never realized how much history there is here, and how friendly everybody is. I am extremely happy to now be working here, and hope to get many Japanese friends, learn Japanese, and explore beautiful Kyushu.

Aim and Goal

K: Why was this department established with the PhD course and what is the aim and goal? What makes the department at Nagasaki special?

F: The purpose of the establishment of this Department is to train university students and researchers at research institutes to be able to play an active role internationally in the field of functional materials and cutting-edge sustainable energy systems that are friendly to the environment. We need an international outlook, English proficiency, and a wide range of knowledge.

At international conferences, I often see researchers who are too busy presenting their own research, and instead I think we should try to make more effort to have more international friends.

In my case, I have served on various committees at international conferences and I think, frankly, that communication skills will be the driving force behind all negotiations.

English skills are very necessary.

From such experience, I'd like to turn out international researchers who can play an active role in foreign countries.

In other words, I want to train outstanding successors. To be able to do that, it is necessary to receive lectures from top international researchers from overseas and to support study abroad.

It also helps students improve their international understanding by communicating with international researchers such as Dr. Kirkland on a daily basis. I would like our students to have the ability to be able to give

presentations at international conferences and write international journal papers.

Especially important recent issues include the development of advanced functional materials related to these next-generation systems, the search for a future society with renewable energy technologies and also breaking away from nuclear power dependency after the Great East Japan Earthquake and Tsunami disaster.

I would love to facilitate broad perspectives among researchers to see the entire area of green energy, such as effective utilizations, the development of the devices and materials.

Future of the Green Systems

K: What do you think about future of this department?

F: The desire to phase out the use of nuclear power reactors in society after the Tsunami disaster has started on a worldwide scale. Additionally, approaching this problem as a non-carbon society is important in the battle

Specialty

K: What is the specialty of the Department of Advanced Technology and Science for Sustainable Development?

F: It is a doctoral research development program with a broad perspective for a total of five years. I would like to train students who have a university degree in one of the following fields: applied physics, mechanical engineering, electrical and electronic engineering, chemistry, or materials engineering. It is important they are not limited to specific areas of knowledge and understanding, but also have the outlook and the ability to try to understand a wide range of fields in Green Systems as well as having the fundamental aptitude such as discovering issues, the ability to pursue ideas, and planning and management of research programs, all of which are necessary to become international researchers working in academia.

To do so, it's very important to acquire a deep expertise of the highly specialized technology used to carry out leading research in the field of devices and systems, the high-performance materials, and other aspects related to effective use of energy to contribute to the sustainable development of society. It is also important to have a level of international understanding (English communication skills, ability to create the English language literature) to be active internationally, practice research skills as a researcher (global spirit of innovation, research planning ability, carry out research force, research leadership). I'd like Nick to contribute to them international education.

against global warming, and must never stopped. I think the Green Energy system is the field that should be addressed. Japan should lead with high efficiency energy software to contribute to the sustainable development of society. With respect to the world's Green Energy, we also have to consider social responsibilities. Therefore, Nagasaki University is aiming to lead the world in research and education in the field of Green Systems.

Special Conversation

Goals of the Department of Advanced Technology and Science for Sustainable Development

Hiroshi Fujiyama × Nicholas Kirkland

Desirable Engineering System

F : By the way, what do you think is a desirable engineering system in near future?

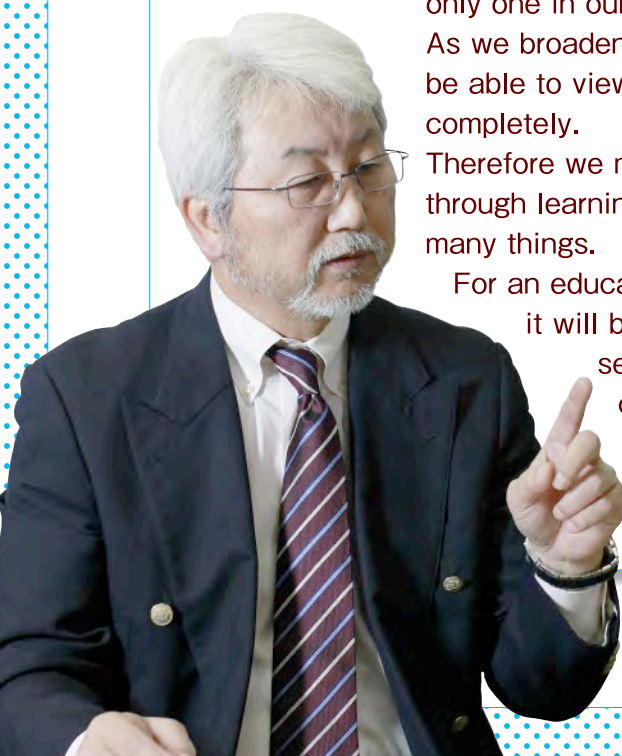
K : Energy. Energy is crucial to everything we do, so it is very important that we do our best to obtain renewable, reliable energy sources. This means that we must consider many things, including the environment and the impact we have on others outside our country. We are one world, one human race; we need to think like a family. Often people do not change until something is a problem, but I think we need to develop and improve new energy systems before there is a problem.

And for me, communicating in Japanese!
And what do you think Fujiyama sensei?

F : Through my experiences, it's very important to think global, as we are one world.

The Earth is very small and there's only one in our universe. As we broaden our horizons, we will be able to view things more widely and completely. Therefore we must acquire knowledge through learning and experiencing many things.

For an educated person in the future, it will be considered common sense to be able to contemplate energy and environment on a global scale rather than country by country.



Qualities and Abilities of a Leading Engineer

F : What do you think are required qualities and abilities for a leading researcher and developer in the engineering field?

K : Intelligence is very important, but not enough. A good engineer is able to see a problem, work out the best way to solve the problem, and implement the solution. To me, this is the very core of what engineering is: problem solving. The exciting and challenging thing about engineering, especially the types of engineering concerning Green Systems, is that the types of problems are very different and require many different skills. So a good engineer/researcher

should be independent, but also use the skills and abilities of his peers/friends to find the best solution. To me, the ideal engineer would be a hard-working but considerate person who likes difficult challenges. The satisfaction you can get from solving a difficult problem is a very good feeling.

F : Yes, I totally agree with you! I'm not impressed with researchers who tend to seize upon the latest topics. I personally believe that research without any references is the most rewarding. But also I think that we should enjoy our hobbies as well as work. Some researchers are only interested in their research. I often tell students, "Be the top with work, and be the top notch with your hobby!" We must enjoy our own lives, so we can make excellent work.

Researcher Nicholas and his International Outlook

F : Which countries have you lived in so far, Nick?

K : I have been very lucky to have lived in many countries. I was born in Virginia, USA, but when I was only a few months old I moved to Ghana for 4 years, then India for 4 years, then Kenya for 5 years, then back to Virginia for 3 years, then Tanzania for 2 years, where I graduated High School. After this I went to Durham University in England where I completed my Masters in Management and Design Engineering. In 2007 I was lucky enough to be awarded a scholarship to complete my PhD at the University of Canterbury in Christchurch, New Zealand. I worked primarily in Biomaterials, designing new materials to replace bone. After this I worked at Monash University in Melbourne, Australia as an electrochemist/materials engineer. I then applied for this job, travelled Southeast Asia for 3 months, and now here I am in Nagasaki!

F : OH, wow! Amazing!! So Japan is the 9th country then!

I have visited various countries to attend the international conferences every year. However, I have only lived in Lausanne in Switzerland for 1 year, in Colorado USA for 1 month and Heidelberg for 2 months, but they were major turning points for me. Switzerland is relaxed, surprisingly beautiful where people respect the environment.

Considering their tourism revenue accounts for one-third of GDP, to protect the natural integrity, like uniformity of the streets with full of flowers, nature conservation of local mountainous is very thorough. This country chooses nuclear power plants in the city

over the hydroelectric power plants which can destroy the surrounding nature. Living in the Europe made me realize that I'm an Asian. It is hard to distinguish if you are Japanese, or Chinese or Korean, so I categorized people into white, Black or Asian. Back then, I could not think it as one world, one race, like you do Nick. My only thought was working hard as a Japanese person. I'm really fascinated with your internationalism. So, Nick, what did you discover through living in many countries? What was the biggest influence in your life?

K : I think the most important thing I have learned from living in many countries is to do my best to adapt to the local people and culture. It is important to keep your heritage and culture, but also embrace the local culture, language, and lifestyle. I also remind myself that I am living in THEIR country, so what I consider "normal" may not be normal for others. It is very important to respect the history and social dynamics of every country, no matter how strange or foreign they might feel. An example is bowing in Japan, which people do not do in most countries I have lived in, but I understand it is about respect and important to the "fabric of life". Therefore I embrace this custom and do as others do. In turn, I hope this provides Japanese with a good impression of my countries.

Food is also another surprisingly important aspect of a new culture, and I believe that you must try everything a new country has to offer, at least twice. Changing your diet, at least partially, is another important step towards integrating yourself into a new country. Personally, I hope one day to be able to make Okonomiyaki, Sarandon, and Ramen (my three favorite foods in Japan) just as well as my Japanese friends.

F : "Food" is surely very important when you are living in the foreign countries. Have you ever had any bad experiences?

K : For me, it was almost entirely a good experience! It can be hard moving every few years, as you have to leave your friends behind and make new ones. But this is a blessing in disguise. By leaving your "comfort zone" and circle of friends, you learn to be open and actively make new friends easily. This is important in life, as friends and making new connections with people is the most important aspect of almost any job and is good for your social life. I think to succeed in life, you have to challenge yourself, and there is no greater challenge than starting as a completely new person in a new country. However, for me, there is also no greater pleasure!

Dream as a Researcher

F : What is your dream as a professor or researcher in the field of engineering?

K : I would like to work in Academia to develop novel solutions to many of the problems facing the world, especially dealing with green technologies and sustainable development. There are a lot of very interesting fields to work in, and a lot of work to do. I think University provides a very good environment to explore exactly what you are interested in, and you are surrounded by intelligent people.

F : Exactly. It is great honored to carry out useful researches that can help people in such a blessed environment like the university.

K : I am also looking forward to helping the students to improve their English skills for presentations and papers. Eventually, in the future, I would like to take my skills and knowledge and create a company that works closely with Universities to develop sustainable, local green energy solutions for poorer communities in the world, especially Africa. I feel it is our duty as humans to help others with the skills we have.

What do you think, Fujiyama sensei?

F : I have been researching plasma applications for 40 years at universities; I feel that with researching, you will never be able to see the clear goal. If you can set your research goal, you are a first-rate researcher and an educator.

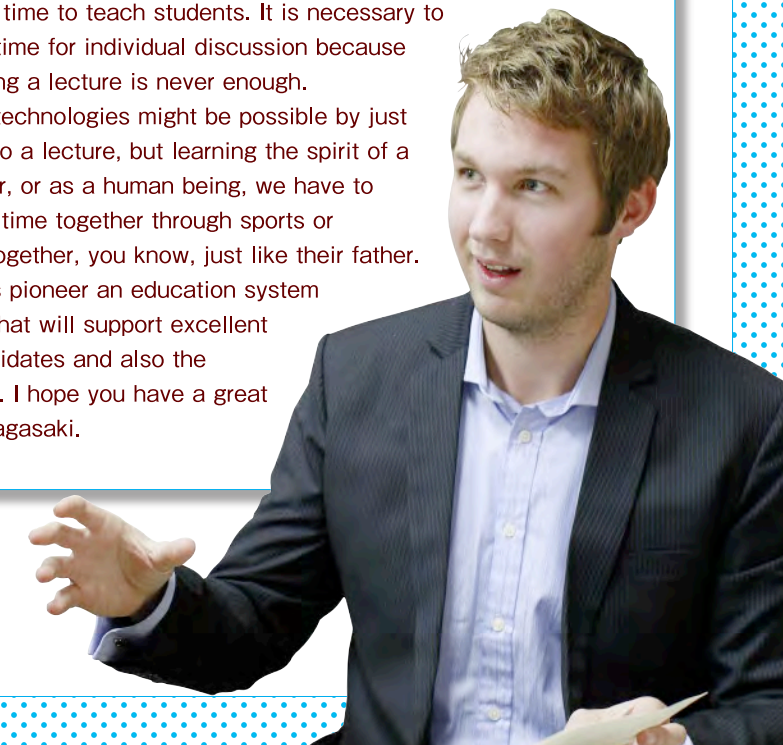
As you say Nick, it would be the best job ever if you can develop the technology which makes people around the world happy. To be able to do so, it is important to make sure our research development actually work at the factory, and helps people rather than just becoming a research paper. Engineering should be the bridge between nature and humanity. Research becomes valuable when it is useful for the people.

I strongly hope to educate our students to be practical and useful researchers for their future.

K : What do you do, day-to-day, in your job?

F : Well, when I was younger, I used to do nothing but research. However, in recent years my primary job is to run international conferences and estimate and review research. I feel sorry that I have less time to teach students. It is necessary to have the time for individual discussion because only getting a lecture is never enough.

Learning technologies might be possible by just listening to a lecture, but learning the spirit of a researcher, or as a human being, we have to share the time together through sports or drinking together, you know, just like their father. Nick, let's pioneer an education system together that will support excellent PhD candidates and also the educators. I hope you have a great time in Nagasaki.





If energy generation is considered from the aspects of electron energy and hydrogen energy, then true innovation will stem from the resource of hydrogen, its evolution and reduction, along with power development and improved energy storage technology. We are aiming to create new energy technologies, utilizing chemical transformation via novel ways of forming and cleavage of carbon and hydrogen bonds at the molecular level. We have been researching the technology to synthesize an alternative energy to oil or fuel by an organic chemical approach, as well as

Alternative Energy Based on Synthetic Chemistry

Professor Masanari Kimura

developing a reduction process without using the hydrogen molecule which has been used until now. Ultimately, we want to be able to perform photosynthesis artificially to make sugars and starch using carbon dioxide that makes food in the natural world by using a more simple technology. For energy development, we are aiming for essential innovation by seeking new breakthrough technologies and chemical transformations, rather than solely from the perspective of environmental issues. To do so, it is important to train human resources who have a particular interest in synthetic chemistry. However, we would like to train educators or technicians who are competitive globally, creating new technologies by not only utilizing the conventional methods. Organic chemistry is one of the most highly competitive fields. We would like students to study a wide range of fields, from the chemical to electric to mechanical engineering. Only then you can develop novel ideas and be able to see the field from a total science perspective. As a faculty we believe creating new technologies to lead the development of such technologies is the best possible contribution to society. I hope that all students will one day become top worldwide researchers.



All human and social activities are, in a way, energy conversion events. We naturally consume energy to live, and therefore we have to produce the energy from somewhere. As for Japan with electric power problems in recent years and inherently poor resources, it is important to develop energy technologies with a broad perspective, to contribute to the sustainable development of society. The education and research related to "Green Systems" must be very extensive; it is desirable to create new functions and new materials from physical and chemical perspectives, then to turn into innovative devices or systems as effective technologies. For example, it is necessary to lead to green innovation, such as the development of new energy resources and high-efficiency energy storage devices which take into account CO₂-emission reduction, for yielding renewable and reproducible energies as well as the power for next-generation vehicle. To do

Development of Next Generation Energy Storage Devices

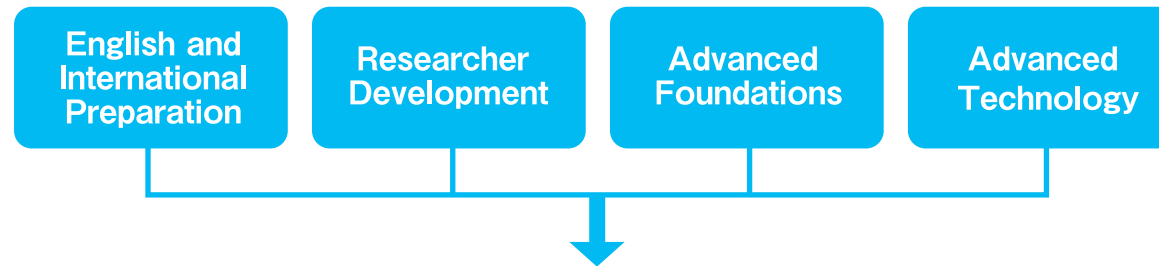
Professor Isamu Moriguchi

this, we aim to create superior technologies and to foster excellent researchers with a broad perspective, under the coordination of interdisciplinary education and research with experts gathered from various fields of engineering. One research effort that we are promoting is the Nagasaki University Priority Research Project "Materials Science for Next Generation Energy" and an Advanced Low Carbon Technology Research and Develop Program of the Japan Science and Technology Agency's Strategic Basic Researches. At the Green Systems Department, we would like to foster researchers who are active in the academic field such as universities and research institutes. In addition, we would like students to aim to be top-class scientists who can confidently conduct creative and pioneering research with wide and international perspective in addition to acquiring professional knowledge and technology.

Graduate School of Engineering 5-Year Doctoral Program Department of Advanced Technology and Science for Sustainable Development

This is a degree in science and technology to support the sustainable development of society.

Primary Course Pillars

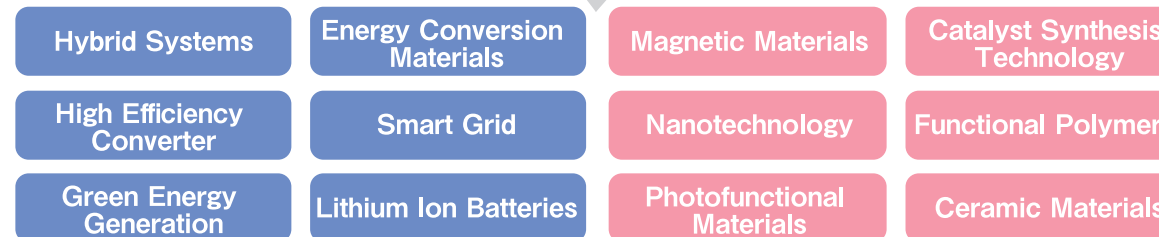


Two courses are provided



Individual research will be performed through these practical education courses.

From Materials Creation to System Development Related to Green Innovation



Our graduates have the potential of becoming researchers or leaders in academia, at national institutes or corporations.

Early Completion

Early completion is possible if a student demonstrates an excellent level of performance.

We have been researching the effective use of biomass fuel, such as alcohol, for diesel engines. The focus of the research is to develop engines with less fuel consumption and clean emissions. In the future, there is a risk of oil depletion as well as a lack of oil supplied to Japan, the idea called Smart Grid arises for electric power relations. If there is a mechanism that allows local production for local consumption for energy resources, there is potential to create a different world.



I view green energy from a Mechanical Engineering perspective.

In our approach we will begin by understanding the details of the physical phenomenon to find out how to use the energy efficiently.

The power generation occupies an important position with current energy problems; therefore researching energy conversion for power generation is crucial.

As part of our classes, we teach the basics, such as turbine operation, using fossil fuel, as well as details of the engine itself.

Aiming for High-Efficiency Fuel Combustion

Professor Hironobu Ueki

connection of each specialized field.

At this department, we would like to nurture researchers who develop new research themes based on the interdisciplinary knowledge beyond the boundaries of their field to lead the world.

Since energy issues involve multiple components, even if we create a complete system, a loss may arise without matching operation.

In creating a mechanism that contributes to society and functions as a system, I believe that researching wide-ranging research areas is necessary as well as cross

For energy sources of electrical power, such as solar and fuel cells, we investigate new methods for extracting the stored energy as efficiently as possible, focusing on the operation of the converter itself.



Concentrating on smart house/grid/communities, we research the potential energy savings from using power conversion equipment in familiar environments such as houses and offices, with the aim to find out how we can most efficiently use the power.

With the rapid spread of devices such as smartphones, and the concurrent explosive growth of communication traffic, a challenge has arisen to improve the power supply support system for data centers. For these reasons, the "Green IT Project" was

established by the Ministry of Economy, Trade and Industry, which I have joined to research "Active Energy

Management", the adaptable mechanism based on new concepts, such as using full

power only when necessary, and powering down when not in use.

Without the help of a power converter, the full efficiency of cloud computing, which relies on power on demand, would not be realized.

We are making a coexisting society "landscape of the future" with nature through the smart energy conversion from the nature (green) energy to the electric (power) using electronics.

In the Green Systems Department, I would like the students to be aware of the "real world", as well as building a solid foundation in the multiple research areas.

In that sense, we have to perform extremely focused research while still learning broadly, increasing the chance of international publications. In addition, in the third year, we have a system to allow students to study abroad for half a year to carry out university research.

While developing an international perspective and fostering researchers who compete in the world, eventually I would like them to remain in Nagasaki.

Realization of Smart Green Power Electronics

Professor Fujio Kurokawa

Faculty and Research Areas

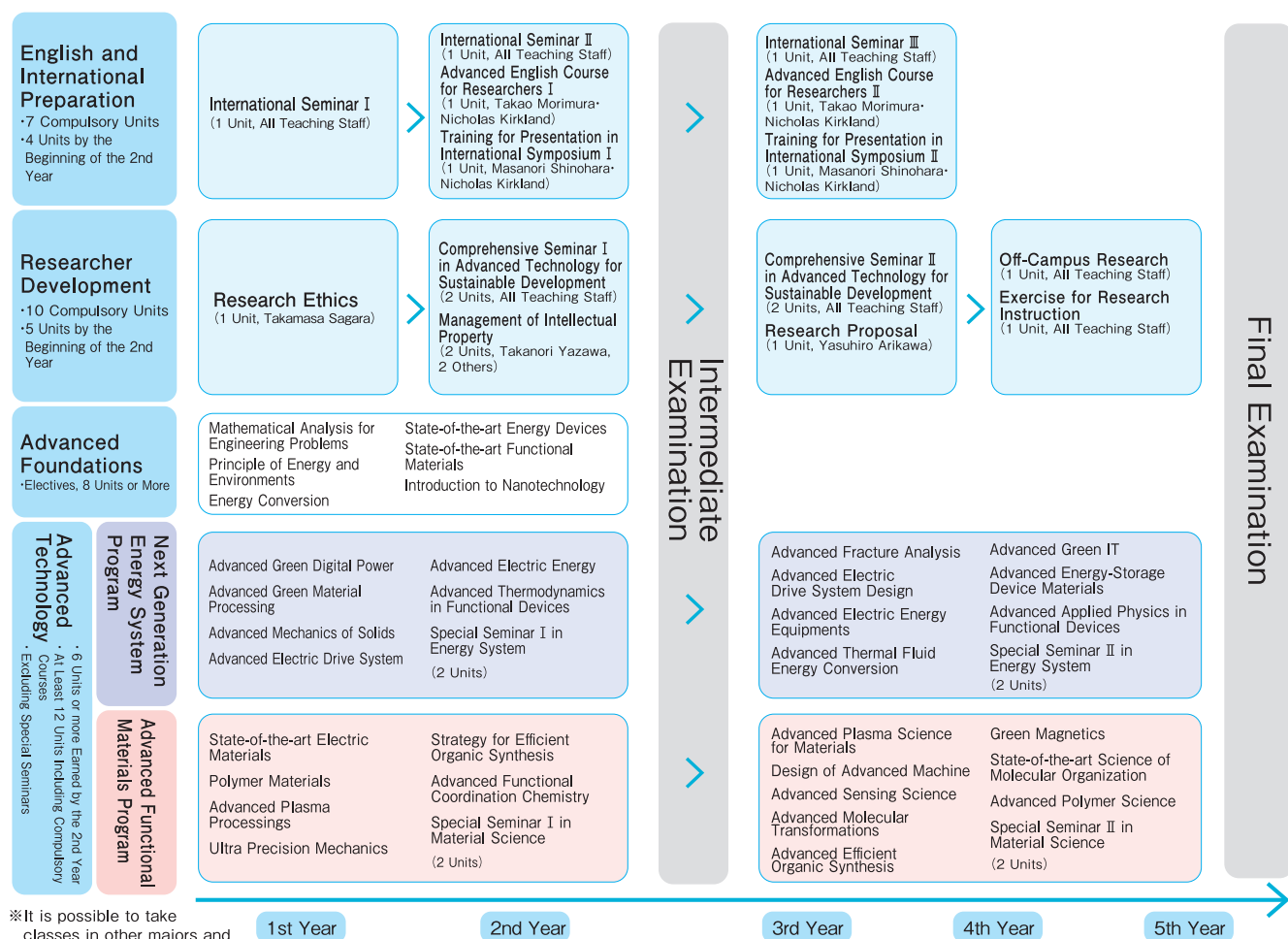
Next Generation Energy System Program

Faculty	Research Area
Hironobu Ueki Professor	Analysis of Liquid Atomization Process
Fujio Kurokawa Professor	Development of Smart Green Power Electronics Circuit
Akihide Saimoto Professor	Analysis of Damage and Fracture in Composites and Bio-materials
Tsuyoshi Higuchi Professor	Development of Rare-earth Less Motor and Novel Wind Turbine Generator
Isamu Moriguchi Professor	Development of Energy Storage Device Materials via Nanostructural Control
Takahiko Yamashita Professor	Design of High Reliability Insulation in Energy Transportation and Conversion System
Takeshi Ohgai Asso. Prof.	Fabrication of Functional Metallic Materials Using Electrodeposition Technique
Takao Morimura Assist. Prof.	Development and Structural Analysis of Thermoelectric Materials
Nicholas Kirkland Assist. Prof.	Electrochemistry, Bio-/Energy Materials Applications

Advanced Functional Materials Program

Faculty	Research Area
Masanari Kimura Professor	Development of Efficient Organic Synthesis for Functionalized Materials
Takamasa Sagara Professor	Advanced Design of Electrified Interfaces for Functional Molecular Assemblies
Yasuhiro Shimizu Professor	Design, Control and Application of Functional Ceramic Materials
Hirotohi Fukunaga Professor	Development of High Performance Magnetic Materials due to Control of Nanostructure
Hiroshi Fujiyama Professor	Advanced Plasma Source and Its Application for Plasma Materials Science
Ken Kojo Asso. Prof.	Development of a Polymer Electrolyte for Energy Storage Devices
Takanori Yazawa Asso. Prof.	Machining and Measurement of Functional Material
Yasuhiro Arikawa Asso. Prof.	Activation of Small Molecules by Transition Metal Complexes
Masanori Shinohara Assist. Prof.	Analysis of Interaction between Plasma and Solid Surface

Curriculum Model



※It is possible to take classes in other majors and research areas.



NAGASAKI UNIVERSITY
GRADUATE SCHOOL OF ENGINEERING
 1-14 Bunkyo Machi, Nagasaki 852-8521, Japan
 TEL 095-819-2491 • FAX 095-819-2488
<http://www.eng.nagasaki-u.ac.jp/>