Achievements for local industry creation

To date, several innovative technologies for sustainable energy production developed by our institute have been utilized by local industries. NJRISE is aiming to translate more of its R&D achievements and fundamental technologies on green and sustainable energy into practical applications for the energy market.

Growing strawberries with geothermal heat (Kuroishi, Aomori)

No-heat-pump type snow-melting system using geothermal heat (Hirosei Co.: a venture company launched by Hirosaki University)

Road direction flash lamp powered by wind even at low velocities (Japan Parts Center Co.)

Education / Public Relations

The 1st Marine Energy International Symposium (July 2012)

NJRISE exhibition booth at Renewable Energy 2012 (Dec.2012)

Forum on Renewable Energy for Citizen (Feb.2013)

Laboratory tour for Citizen (Feb.2013)

Equipments

*Advanced evaluation system for fuel cells
*Set-ups for biomass gasification
*High-temperature electric furnaces
*Gas supply system
*Gas analysis system
*Various control and measurement machines
*Desktop-type precise pressurization module
*Press pressure system
*Low-temperature cooling system
*Pulverization/Mixing machines
*Scanning Probe Microscopy (SPM)
*3D precision molding machine
*Commutator-less reduction set-up
*Infrared camera
*Hydrogen purification system
*Multi-channel digital signal measurement system
*Heat flux type differential scanning calorimeter
*Ultrafine particle production set-up
*Inductively Coupled Plasma Atomic Emission Spectrometer (ICP-AES)
*Ultrapure Water Systems
*High-energy planetary ball milling apparatus
*Vacuum heat treatment equipment with press
*Combinatorial Energy Materials Synthesis Equipment
*Catalyst Analysis System
*Micromeritics Automatic Surface Area and porosimetry Analyzer
*Fourier Transform Infrared Spectrometer
*Electrochemical Measurement Apparatus
*D/H · O Isotope Water Analyzer
*Ion Chromatograph System for Anions and Cations analysis
*Ultra-pure Water and Pure Water System
*Electric Vehicle System
*Bio-gas Engine Generation efficiency Management Unit
*Inverter Analyzer
*Generated Electric Power utilization Efficiency Measuring System
*Bio-gas-engine Exhaust Emission Measuring Equipment
*Evaluation System for Devices on Electrified Vehicle
*Speciation analysis system of arsenic and selenium
*Evaluation System of Energy Efficiency Technology
*Thermal Diffusivity Measurement System
*RHEED Monitoring System
*Electrode Depositoin System
*Scanning Electron Microscope with Energy-dispersive X-ray Spectroscopy
*In-Plane-type X-ray Analyzing System
*Energy Conversion Analysis System
*Web-based e-Learning System (WebELS)

North Japan Research Institute for Sustainable Energy (NJRISE)

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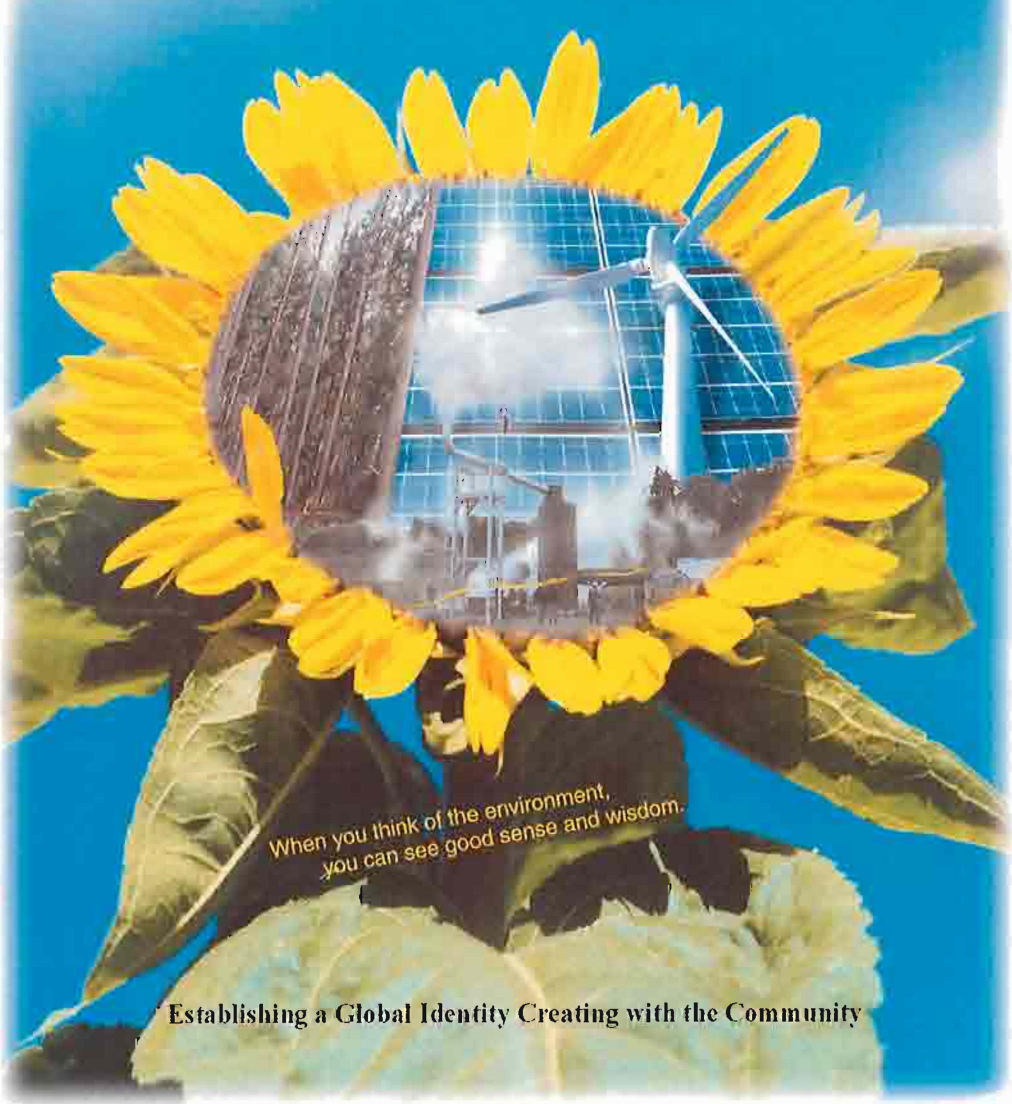
HIROSAKI UNIVERSITY

North Japan Research Institute for Sustainable Energy (NJRISE)



"Establishing a Global Identity Creating with the Community"

Hirofumi Muraoka
Director, Professor,
North Japan Research Institute for Sustainable Energy
(NJRISE), Hirosaki University

Message from Director

Abnormal weather related to global warming is already going on a rampage as seen in the appearance of the global-scale arctic oscillation and frequent strikes of tornadoes which used to be very rare in Japan. Nevertheless, short-term policy tends to take first priority economy rather than environment. This obviously shifts the environmental loads onto future generations. Thoughtful Japanese mind, which won general applause when we faced the Great East Japan Earthquake, should also lead mitigation of global warming.

North Japan Research Institute for Sustainable Energy (NJRISE), Hirosaki University, was established in October 2010 to overcome negative characteristics such as heavy snowfall and cold weather in northern Japan through research and development on renewable and saving energy, and to contribute to construct indigenous and dispersive type local energy industries. The succeeding Great East Japan Earthquake unintentionally demonstrated the foresight of establishment of NJRISE. An institute of universities labeled with the two keywords, "North Japan" and "Sustainable Energy", is only one base in Japan so far. Since the establishment of NJRISE, we needed a few years to introduce fundamental facilities. However, it is time to come into produce a variety of outcomes. Hirosaki University launched Sustainable Energy Course, the Graduate School of Science and Technology in April 2013 where NJRISE has been in charge of the systematic graduate education on sustainable energy.

The times call for advanced innovation from local districts in Japan, particularly for regeneration of local economy. NJRISE is willing to play a role of a local research platform conducting to achieve innovation in collaboration with local communities in northern Japan. We appreciate your widespread support and collaboration.

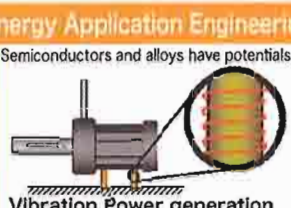
Advanced Energy Materials Group

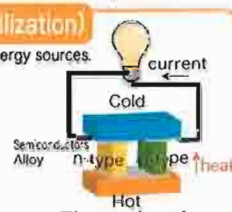
"The challenge to the future energy society by advanced materials"

What kind of material technology tows future Japan?

Energy Application Engineering (Electrical generation・Heat utilization)

Semiconductors and alloys have potentials which generate the electric power from various energy sources.





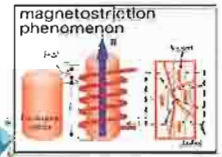
Vibration Power generation using magnetostriction alloys
Energy Harvesting

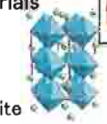
Development of Silica Reduction Process for Solar cells

Themoelectric Materials

Smart sensor application (Power Saving/Secure/Safty)

1) new materials for sen sors and actuators
2) original intelligent materials/devices
3) perovskite oxides (Dielectric materials and functional materials)





Perovsikite

High sensitive torque magnetostriction sensor for automobiles

High sensitive Multiferroics MagneticSensors

Overview

The weak point of renewable energy has quite low energy density that causes the large increase of its cost. Since the energy conversion using a semiconductor and metal including a solar battery can carry out direct conversion to the electrical and electric equipment and there is almost no flexible region, it is suitable for exploitation of renewable energy with a low energy density. The goal of our research is the realization of energy-saving and safe society with our advanced energy and smart materials. Our research fields are energy application engineering and smart sensor application.

(1)Energy Application Engineering

The study of silica reduction process for solar cells, combinatorial material exploration for thermoelectric materials, the development of oscillating generating devices and application to wind and wave power farm.

(2)Application to smart sensors

Development of the magnetostrictive torque sensor for Electric Vehicles with steering-by-wire(SBY) control system, magnetic sensors of multiferroics, and dielectric materials for automobile devices.

Professor Yasubumi FURUYA

Research Interests:

The fundamental technologies of developing more efficient energy conversion/saving devices and a safe machines and structures for smart social system are studied mainly indicated below.

- Several kinds of energy conversion materials and devices(actuator sensor)
- Environmental power generation technologies such as vibration energy harvesting devices with sensing functions
- Wireless multi-functional SAW sensor, etc.

Selected publications

(1) R.Zarnetta, R.Takahashi, M.L.Young, A.Savan, Y.Furuya, S.Thienhaus, B.Maaß, M.Rahim, J.Frenzel, H.Brunken, Y.S.Chu, V.Srivastava, R.D.James, I.Takeuchi, G.Eggeler, A.Ludwig, "Identification of Quaternary Shape Memory Alloys with Near-Zero Thermal Hysteresis and Unprecedented Functional Stability", Advanced Functional Materials, 20(12), (2010)1917–1923.

(2) J.Cui, Y.S.Chu, O.O.Famodu, Y.Furuya, J.Hattrick-Simpers, R.D. James, A.Ludwig, S.Thienhaus, M.Wuttig, Z.Zhang and I.akeuchi, "Combinatorial search of thermoelastic shape-memory alloys with extremely small hysteresis width", Nature Materials, 5(4),(2006)286-290.

Associate professor Kenji ITAKA

Research Interests:

Development of new materials and process research on energy conversion materials

- Development of the low-cost high-purity silica reduction process for solar cells
- Exploration of thermoelectric materials, dielectric materials for capacitors, electric double layer devices with combinatorial technique
- Research of semiconductor devices connected with energy saving and saving resources

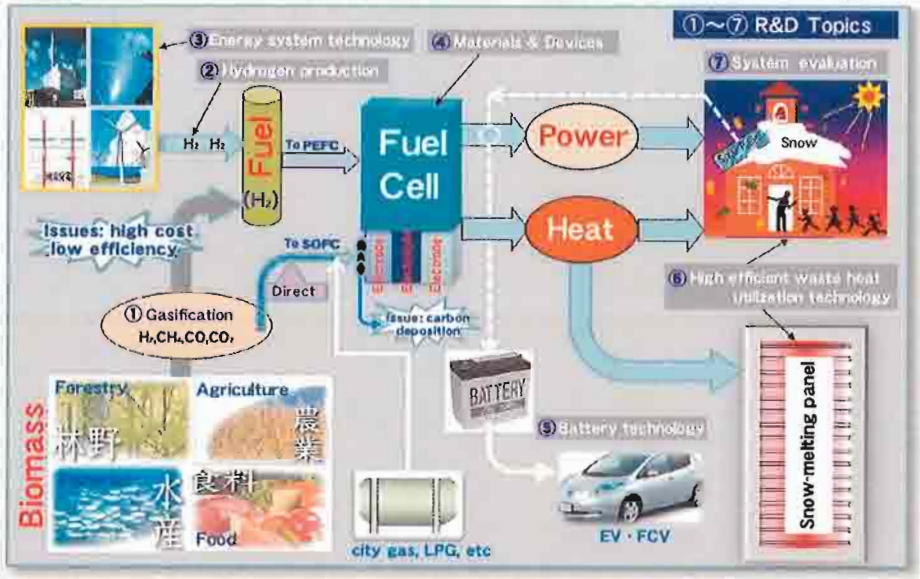
Selected publications

(1) K.Itaka, M.Yamashiro, J.Yamaguchi, M.Haemori, S.Yaginuma, Y.Matsumoto, M.Kondo, H.Koinuma, "High-mobility C60 field-effect molecular-wetting controlled transistors fabricated on substrates", Advanced Materials, 18(13), (2006) 1713–1716.

(2) M.Otani, N.D.Lowhorn, P.K.Schenck, W.Wong-Ng, M.L.Green, K.Itaka, H.Koinuma, "A high-throughput thermoelectric power factor screening tool for rapid construction of thermoelectric property diagrams", Applied Physics Letters, 91(13), (2007) 132102.

Energy Conversion Engineering Group

Toward sustainable low carbon society utilizing potential renewable energy resources in North Japan



Overview

Renewable energy resources are benefit to our environment but behave low energy density, high cost and instability of the supply so that they are still difficult to be used in a large-scale for the realization of low carbon society to date. Therefore, the development of advanced technologies for the application of renewable energy resources and the best mix of them with the energy conservation in accordance with the regional characteristics are essential. Development of innovative green technologies for the combination of fuel cells with various renewable energies such as biomass could especially contribute to the best mix of energies in snowy cold regions by the maximum use of the local energy resources. In our group, biomass, fuel cells, and the best mix of the both are main research topics. It is expected to achieve our objectives with the cooperation of affiliated local government, industries, domestic and overseas academic organizations.

Professor **Abuliti ABUDULA**

Research Interests:

- Fuel cells: including solid oxide fuel cells (SOFC) and polymer polymer electrolyte fuel cell s(PEFC)
- Secondary battery and storage battery
- Energy conversion materials and environmental materials
- Hydrogen production and utilization technology
- Waste heat utilization technology
- Cogeneration technology
- Energy resource evaluation and energy policy

Selected publications

(1) G. Chen, G. Guan, Y. Kasai, A. Abudula, "Nickel volatilization phenomenon on the Ni-CGO anode in a cathode-supported SOFC operated at low concentrations of H2", International Journal of Hydrogen Energy, 37(1)(2012) 477-483.
(2) G. Chen, G. Guan, Y. Kasai, H. You, A. Abudula, "Degradation mechanism of Ni based anode in low concentrations of dry methane", Journal of Power Sources, 196(15)(2011)6022-6028.

Associate professor **Guoqing GUAN**

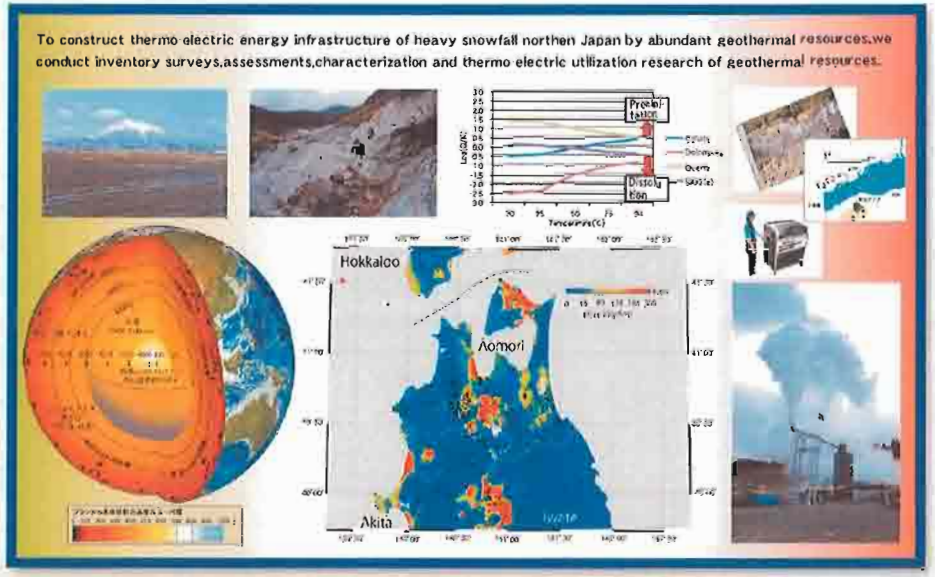
Research Interests:

- High-efficiency biomass/coal conversion technology: catalysts for gasification; BTL catalysts; Gasification process design; Oil derived from biomass/coal
- Fuel gas purification and CO_2 adsorption technology
- Energy materials for fuel cells and supercapacitor
- Separation/recovery of value-added metal ions from wastes

Selected publications

(1) G. Guan, G. Chen, Y. Kasai, E.W.C. Lim, X. Hao, K. Malinee, A. Abudula, "Catalytic steam reforming of biomass tar over iron or nickel-based catalyst supported on calcined scallop shell," Applied Catalysis B: Environmental, 115-116(2012)159-168.
(2) G. Guan, C. Fushimi, M. Ishizuka, Y. Nakamura, A. Tsutsumi, S. Matsuda, Y. Suzuki, H. Hatano, Y. Cheng, E. W. C. Lim, C. H. Wang, "Flow behaviors in the downer of a large-scale triple-bed combined circulating fluidized bed system with high solids mass fluxes," Chemical Engineering Science, 66(18)(2011)4212-4220.

Geothermal Engineering Group



Overview

Japan is poor in most of natural resources, but has ca. 8% of world active volcanoes so that Japan is blessed with the third largest hydrothermal resources in the world. North Japan is particularly dominant in geothermal resources. Geothermal resources can be used not only for power generation but also for direct thermal application. Some sort of a geothermal utopia can be seen in Iceland where space heating is a life line which is fully protected by abundant geothermal power generation and geothermal space heating.

However, geothermal resources are not necessarily used in North Japan. For instance, none of geothermal power plants have been built in Aomori Prefecture up to now. Our group aims at research accelerating geothermal utilization as follows: (1) Investigation on the distribution of geothermal resources in North Japan. (2) Studies on short-term applications such as direct geothermal use and hot spring power generation. (3) Studies on long-term applications such as the feasibility of relatively large-scale geothermal power plants and the next-generation geothermal power exploitation methods.

Professor **Hirofumi MURAOKA**

Research Interests:

I was engaged in geothermal geology of clustered calderas and associated geothermal resources in Aomori Prefecture for 20 years during younger ages. My long years of wish is to realize the construction of geothermal power plants in Aomori Prefecture.
I would also study cascade utilization of abundant hot water used in the geothermal power plants for space heating and snow melting.

Selected publications

(1) Muraoka, H., Asanuma, H. and Ito, H. Understanding geothermal systems in ductile zones and their perspective for power generation with engineered geothermal system technologies. Journal of Geography (Chigaku Zasshi), 122, (2013) 343-362. (in Japanese with English abstract).
(2) Muraoka, H. Chapter 35 Geothermal Energy. In: "Handbook of Climate Change Mitigation", Springer, (2012) 1325-1353.

Associate Professor **Seiichiro IOKA**

Research Interests:

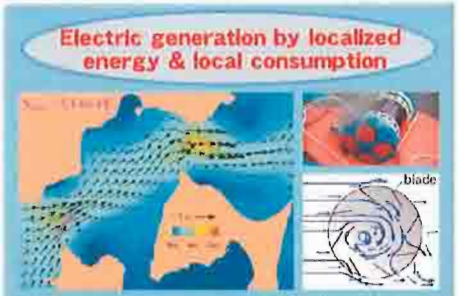
The use of shallow geothermal heat is considered effective in melting snow, etc. Therefore, we study the mechanism of thermal conductivity in shallow ground and evaluate heat exchange resources.
Then, we study shallow geothermal potential evaluation and the various aspects involved in it. In addition, we study environmental impact assessment and evaluate geothermal resources for geothermal power generation using hydrological and geochemical methods.

Selected publications

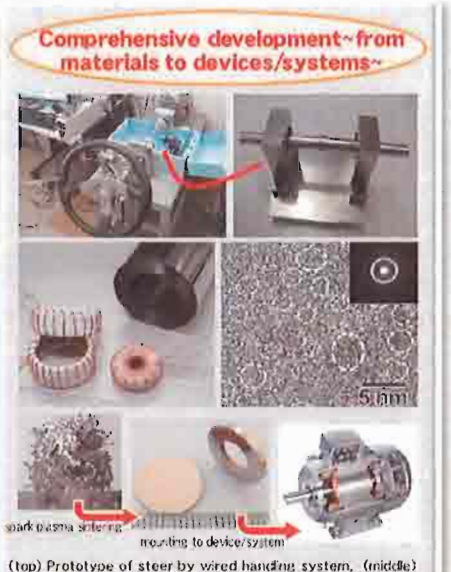
(1) Ioka, S., Muraoka, H., Naniyo, H., Fujii, H., Sakamoto, H. and Osanai, T.: Apparent thermal conductivities in Aomori Prefecture. Journal of Geothermal Research Society of Japan, 35(3), (2013) 105-110.
(2) Ioka, S., Sakai, T., Igarashi, T. and Shijima, Y.: Determination of redox potential of sulfide groundwater in unconsolidated sediments by long-term continuous in situ potentiometric measurements. Environmental Monitoring and Assessment, 178(1-4), (2011) 171-178.

Electric System Engineering Group

Schematic of a developing vehicle and small methane gas engine.



Ocean current map in Tsugaru channel, acoustic Doppler current profiler (ADCP) and simulation of low velocity turbine.



(top) Prototype of steer by wired handing system, (middle) fabrication and characterization of soft magnetic materials, (bottom) device development by metallurgical method.

Overview

Hybrid Electric Vehicle (HEV) and Electric Vehicle (EV) production come out with plans to reduce global warming gas emission and fuel consumption. However, in the cold and snowy area's condition, total travel distance, safety performance and heat reservoir system become the new tasks in HEV/EVs. Hence, it is necessary to adopt strategies that would make these industries not only safe for human dwellings but also conform to internationally accepted environmental protection guidelines and code of ethics.
The primary aim of our group is the development of electrified cars stationed in Aomori, one of the coldest and snowy regions in Japan. We are trying to overcome the problems that might emanate from the above. We are also developing novel materials and examine system that would assist in achieving our objective. Moreover, power electronics as a fundamental technology is also a main part of our researches that will contribute to the effective applications of ocean current, tidal power and wind power.

Professor **Munekatsu SHIMADA**

Research Interests:
High efficiency sensing devices with magnetic alloys for electromagnetical field, mechanical torque, pressure and acceleration, high power electric devices such as motors, generators and so-forth, bio-methane-gas burning engine and related technology, ocean current/tidal power generation, heat cascade utilization in energy generation system, and materials design for soft/hard magnetic alloys, liver alloys, magnetostrictive materials and structural materials.

Selected publications

(1) M. Shimada, "A vehicle driven by electricity, designed for cold and snowy areas", Sensors and Actuators A , 200(2013) 168-171.
(2) S. Hori, T. Okazaki, Y. Furuya, M. Simada, M. Yokoyama, M. Nakamura, "Effect of Heat Treatment under Stress on Torque Sensing Using Magnetostrictive Materials Transactions, 53(2012)963-967.

Associate professor **Takeshi KUBOTA**

Research Interests:
Fabrication and characterization of soft magnetic alloys and their applications for motor core, transformer core, reactor mounting on electric vehicles and energy harvesting in environment, synthesis of soft magnetic materials, non equilibrium metallic materials and multi ferroic materials with functional/useful properties, and their related technology particularly materials processing of amorphous and nanocrystalline alloys with magnetic softness.

Selected publications

(1) T. Kubota, T. Okazaki, N. Endo, K. Mikami, Y. Furuya, "Output characteristics in Fe-Pd/PZT/Fe-Pd magneto electric composites with Fe-Pd thick layer", Sensor and Actuator A, 200 (2013) 11-15.
(2) T. Kubota, A. Makino, A. Inoue, "Low core loss of Fe-Si-B-P-Cu nanocrystalline alloys with high B and B", Journal of Alloys and Compounds, 509S, (2011)416-419.

Graduate School
of Science and Technology

Educational Goals

Hirosaki University strives to provide a high level of education to future global and local leaders in a wide range of specialized fields. The university's general education program instills a strong sense of humanity and social responsibility, while the core curricula in the various specialized academic programs help students develop the know-how and the confidence to grapple with the rapid changes taking place in modern society. All of these academic programs are geared to conform to the university's commitment to the study of energy, the environment and food production. This commitment extends not only to the hard sciences , but also to the human and social sciences.

MASTER'S COURSE of Sustainable Energy Engineering
Field of Research
Advanced Energy Materials
Energy Conversion Engineering
Geothermal Engineering
Electric System Engineering

DOCTORAL COURSE	
Course	Field of Research
Course of Advanced Materials Science and Technology	Functional Materials Chemistry
	Materials Processing Physics
Course of Safety Science and Technology	Environmental and Safety Sciences
	Safety System Engineering

With the Aim of Advanced Science and Technology Educations

The Graduate School of Science and Technology (Master's course) considers education as the most important duty, and aims to bring up highly specialized engineers who can adapt themselves to the progress and diversity of science and technology. The course provides advanced science and technology education under the consideration of the importance for the close connection between the education of the undergraduate program and that of the master's program

Creation of Advanced Science and Technology in the Future

The Graduate School of Science and Technology (Doctoral Course) consists of two courses of Advanced Materials Science and Technology and Safety Science and Technology. The former covers the development of useful materials and their application technology and the latter does crisis-controlling technology for natural and human-originating disasters in the highly developed society. Each course aims to bring up engineers who will be able to solve problems with a flexible and perspective consideration from the whole situation.

University structure