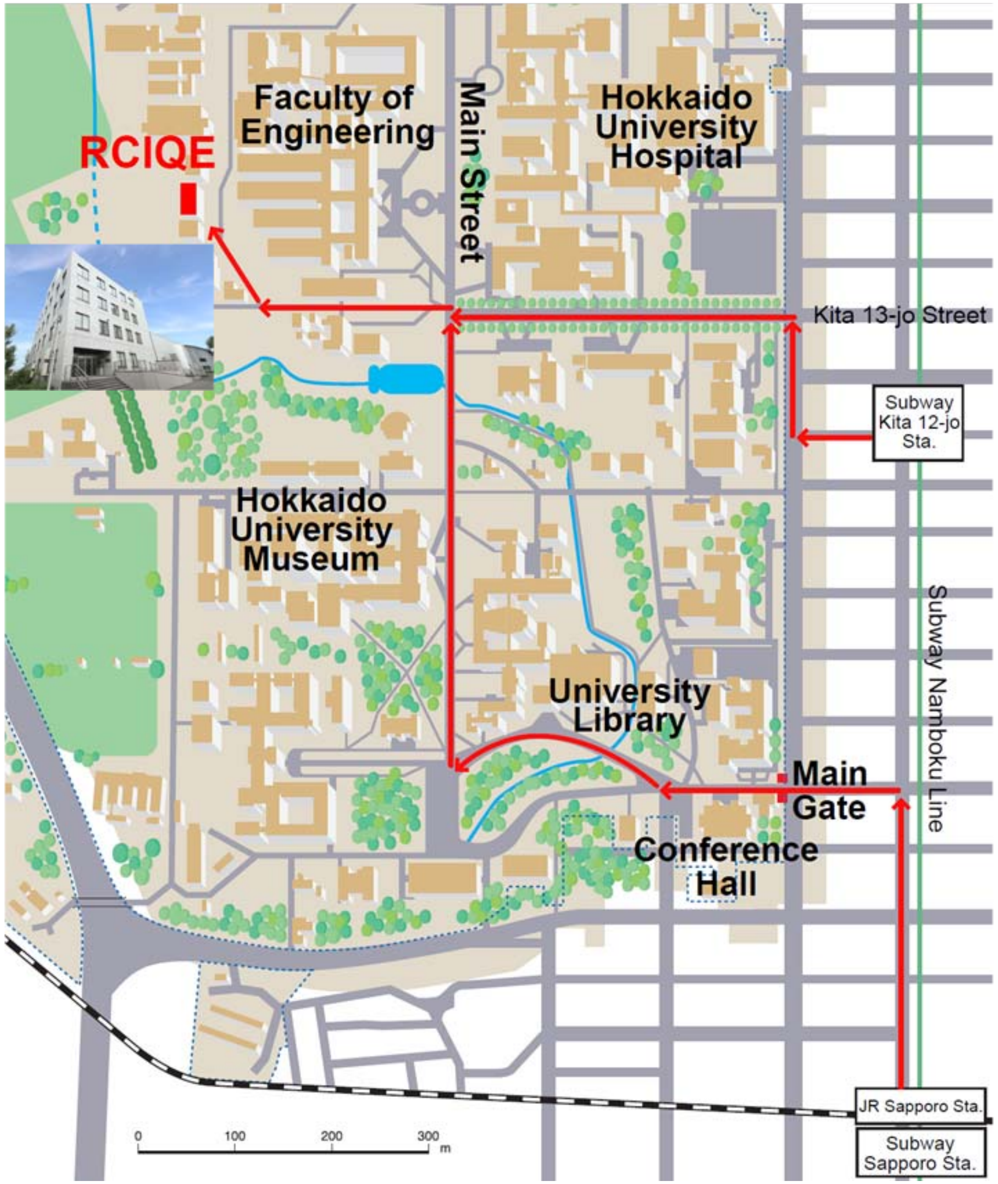
■Access Map



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Research Center for Integrated Quantum Electronics (RCIQE)

量子集積エレクトロニクス研究センター

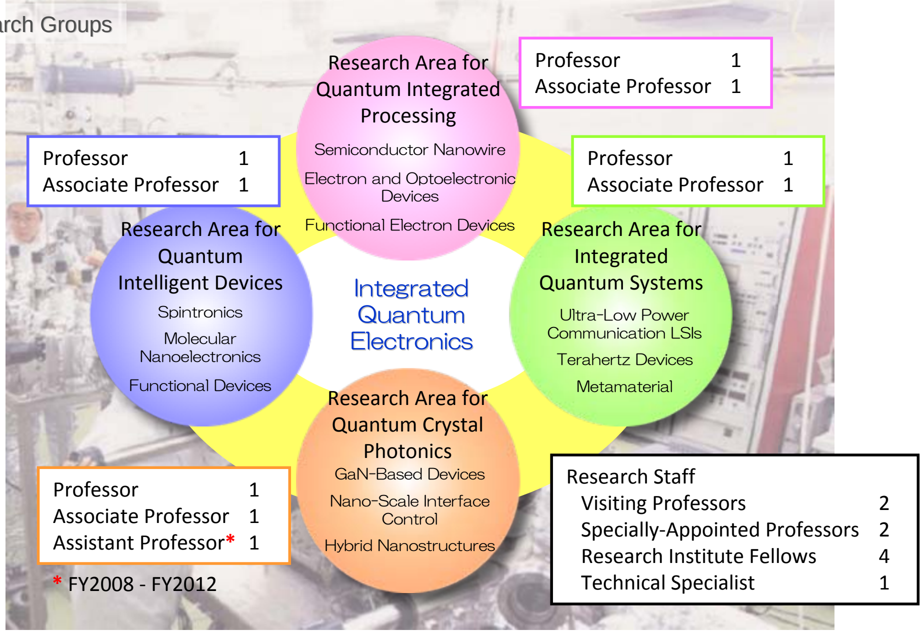
学内共同教育研究施設

Hokkaido University
北海道大学

■Objective of RCIQE

Research Center for Integrated Quantum Electronics (RCIQE) promotes research on nano-electronics based on semiconductor nanotechnology guided by two basic concepts:
(1) Need for creating innovative technologies required for materialization of a highly information-based green energy society via science & technology that utilize the quantum-mechanical effect, and transferring the findings of research on cutting-edge electronics to the industrial circle for practical applications through collaborative research.
(2) Pursuit of the scientific principles, underlying the fabrication of novel semiconductor nanostructures as well as the factors that control the physical properties and structure of the novel nano-materials, aiming at promotion of applied research linked to production of the green energy and ultra-low power consumption devices and integrated circuits. This requires promoting research in various research areas at global scale while ensuring the successive transfer of the knowledge accumulated in science and technology to new generation of researchers.
In order to respond to very strong demand for “low environmental stress” technology essential for realization of a low carbon society, RCIQE has been prioritizing research in the field of environmental-friendly, low-energy and integrated quantum electronics.

■Research Groups



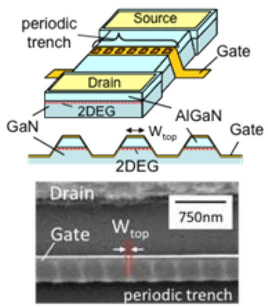
Research Area for Quantum Crystal Photonics

Prof. Tamotsu Hashizume, Assoc. Prof. Shinjiro Hara, Assist. Prof. Hiroaki Koga

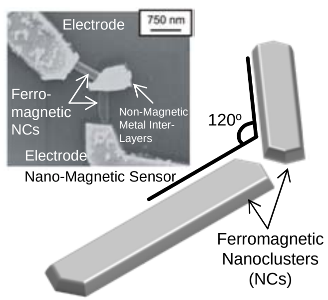
The research target is fabrication and characterization of advanced nanostructures with high density and periodicity, on the basis of GaN-and GaAs-based semiconductors. The control of electronic and photonic properties of such nanostructures leads to various kinds of novel devices applicable to next-generation integrated systems and power conversion systems.

1) Interface control of GaN-based heterostructures
2) GaN-based power transistors for next-generation inverters
3) Novel bottom-up fabrication method for ferromagnetic/semiconducting hybrid nanostructures and magneto-nanoelectronic device applications

Originally developed Multi-Mesa-Channel AlGaN/GaN Transistor (MMC-HEMT)



Novel Bottom-Up Fabrication Method for Ferromagnetic Nanoclusters and Magneto-Nanoelectronic Device Applications



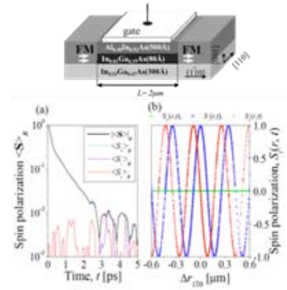
Research Area for Quantum Intelligent Devices

Prof. Kanji Yoh, Assoc. Prof. Taketomo Sato

The objective of the project is to create new-functional devices based on various types of low-dimensional quantum nanostructures fabricated utilizing molecular beam epitaxy (MBE), self-assemble formation techniques and so on. Based on the control of electronic spin system, we are trying to develop the new and various functional devices for the realization of the quantum information-processing.

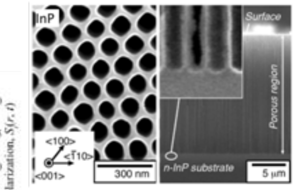
1) Semiconductor spin transistors
2) Graphene monolayer transistors
3) High-efficiency energy-conversion devices

Spin transistor technology



Optimal estimation of spin-diffusion time and diffusion length

Self-assembled formation of semiconductor porous structures



High-efficiency energy-conversion utilizing a large pore surface as a reaction field

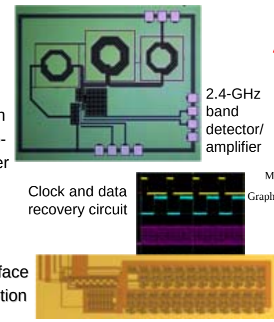
Research Area for Integrated Quantum Systems

Prof. Eiichi Sano, Assoc. Prof. Masamichi Akazawa

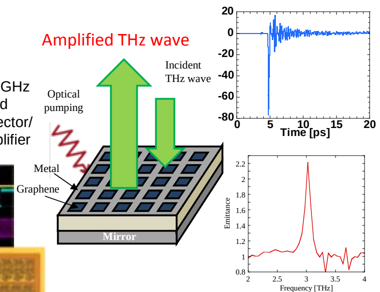
In order to deploy future ubiquitous network, communication circuits and devices are being investigated in this laboratory. The research activity includes terahertz devices and electromagnetic materials using nano-carbon such as carbon nanotube and graphene, microwave circuits based on metamaterial design concept, electronic property of InAlN/GaN hetero-interface, and CMOS sensor LSIs with μ-W power consumption.

1) Novel nano-carbon materials and devices
2) Metamaterials integrated with Si CMOS
3) Electronic property of InAlN/GaN hetero-interface
4) CMOS sensor LSIs with μ-W power consumption

CMOS sensor LSI with μ-W power consumption



THz amplifier with graphene (EM simulation)



Research Area for Quantum Integrated Processing

Prof. Takashi Fukui, Assoc. Prof. Seiya Kasai

Main subject of this laboratory is research and development of semiconductor-nanowire-based devices and related technologies for green electronics. The semiconductor nanowire potentially realizes ultra-low-power consumption and highly efficient operation of the electron and optoelectronics devices, since it can concentrate and control the electrons and photons in one dimension with small energy. The nanowire is formed by selective-area crystal growth technique and it is applied to ultra-low power consumption transistors, solar cells, light emitting devices, functional electron devices, and their integrated systems.

1) Formation of III-V semiconductor nanowire by selective area crystal growth
2) Nanowire-based electron and optoelectronic devices
3) Functional electron devices