CEDI Summer Seminar Program

Academic Melting-Pot 2008

Program Book

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CEDI Summer Seminar Program for Electronic Devices

Academic Melting-Pot 2008 (AMP2008)

Osaka University Global Center of Excellence (GCOE) Program, "Center for Electronic Devices Innovation" organizes a residential, four-week summer seminar program AMP2008 for young researchers, focusing on the topic in electronic devices, which is held on July 7 - August 1, 2008. The seminar mainly takes place at Osaka University as a research internship program. The purpose of the seminar is to provide young researchers with opportunities to learn the research topics of frontier electronic devices, progressed within the GCOE program.

Program contents

The program consists of a four-week international research and several activities.

International Research Experience

- Internship research focusing on theoretical or experimental electronic devices at one of the prestigious laboratories in Osaka University.
- Meeting for research reports by participants in the final week.

The research experience will enable the participants to:

–Conduct hands-on research in electronic devices through collaboration in an international research effort

–Develop inter-cultural skills through placement in a Japanese research laboratory

–Establish strong research networks to facilitate further study and international collaboration in the field of electronic devices

Other Activities

Seminar Tour in Fukui Pref.

Field Trips to Industrial Companies etc.

AMP2008 Program Committee

Chair: Akihiko Fujii

Member: Masashi Yoshimura, Shintaro Hisatake, Fumitaro Ishikawa, Norimasa Ozaki, and Shihoko Kurosaki

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Global Centers of Excellence Program

Based on assessments of the "21st Century COE Program" and verifications of its results to date carried out by Japan's Ministry of Education, Culture, Sports, Science and Technology (MEXT) from FY2002, a decision was made to establish the "Global COE (Centers of Excellence) Program". The program will provide funding support for establishing education and research centers that perform at the apex of global excellence to elevate the international competitiveness of the Japanese universities. The program will strengthen and enhance the education and research functions of graduate schools, to foster highly creative young researchers who will go on to become world leaders in their respective fields through experiencing and practicing research of the highest world standard.

From the website of JSPS (Japan Society for the Promotion of Science)

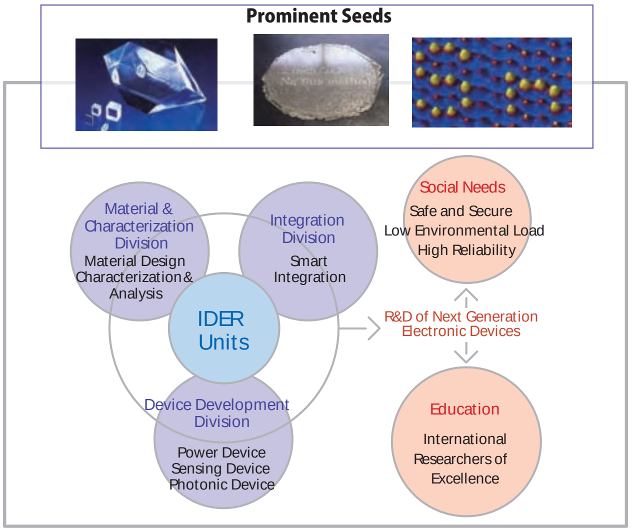
Center for Electronic Devices Innovation

Center for Electronic Devices Innovation had been selected as one of those top-level projects in 2007. The mission of CEDI at Osaka University is to perform education and research/development based on practical science that will:

1) provide opportunities to carry out R&D in three device categories such as power, sensor and photonic devices for a "safe and comfortable," "low environmental load," and "highly reliable " society in the future.

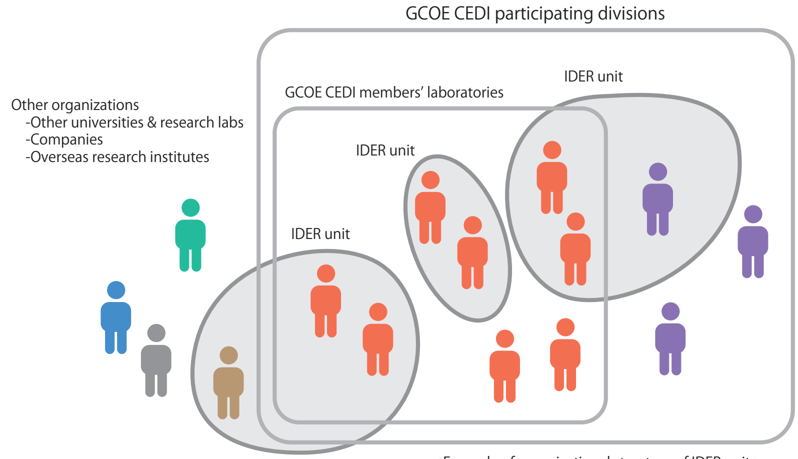
2) provide the training for PhD course students as well as young researchers to successfully pursue a rewarding career in academia and industries.

3) contribute strongly to advancements in electronic devices by using new materials, computer simulation and smart integration technologies.



Innovation-oriented Dynamic Education and Research Units

The IDER unit, Innovation-oriented Dynamic Education and Research unit, is a new education and research platform, generally consisting of young researchers, including academic staff, postdoctoral researchers and doctoral students, from two or more laboratories of the CEDI members. Some IDER units are established specifically for collaborations with other institutions, companies and overseas organizations.



<Example of organizational structure of IDER unit>

We have built IDER units according to the following policies:

1. Each unit must clearly define its strategic R&D goals.
2. Complementary and cross-disciplinary collaboration units, which involve various research organizations in Japan and abroad with their developed own technologies, must be formed.
3. The unit structure must be dynamically reinforced in response to the past development of research activities.
4. The unit must provide a venue for young researchers to conduct independent activities.

Research Project	Project Leader
(a) Flexible and printable organic optical devices	Dr. Hirotake Kajii
(b) Advanced wide bandgap semiconductor	Prof. Masashi Yoshimura
(c) Advanced bio-imaging system	Prof. Makoto Osanai
(d) Concept invention for next generation power semiconductor devices	Prof. Yushi Miura
(e) Smart integrated sensing system	Prof. Toshimasa Matsuoka
(f) Simulation technology for electronics devices innovation	Prof. Nobuya Mori
(g) Terahertz sensing and imaging systems	Dr. Iwao Kawayama
(h) Advanced photonic devices for new-generation communication networks	Prof. Masatoshi Fujimura
(i) Plasma photonic device generating high luminescent electromagnetic radiation toward diagnostics of electronic device material	Dr. Yuichi Inubushi
(j) Exploration of new materials toward innovative electronic devices	Dr. Norimasa Ozaki
(k) High quality HTS-SQUID by Improvement of GB junction properties	Dr. Tetsuro Maki
(l) Advanced high-performance organic photovoltaic device	Prof. Akihiko Fujii
(m) Advanced optical electrical interface	Dr. Shintaro Hisatake
(n) Concept Invention for next generation power semiconductor devices	Mr. Ryota Murai

Flexible and Printable Organic Optical Devices UNIT

Project Leader

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Supervisor

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Project Outline

In this IDER unit, novel intelligent materials are investigated utilizing organic and inorganic hybrid materials. Flexible and printable organic optical devices are realized utilizing these new electronic materials. Novel electric systems are achieved through the combination of organic optical devices and silicon devices to realize large area flexible optoelectronic integrated devices.

Advanced Wide Bandgap Semiconductor UNIT

Project Leader

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Project Outline

This unit focuses on development of new electronic devices based on wide bandgap semiconductors. We attempt to grow high-quality GaN substrates by liquid phase epitaxy, and to fabricate high-frequency and high-power electronic devices on the substrates. The crystal surfaces and defects are also analyzed by original techniques like CAICISS.

Advanced Bio-Imaging System UNIT

Project Leader

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Project Outline

In order to advance the medical and biological research, spatio-temporal analyses of the biological events are needed. For revealing the mechanisms of biological events, an imaging study has great potentials, since that can monitor simultaneously the responses from a large number of neurons or molecules. However, the existing imaging devices lack the spatio-temporal resolution to measure the dynamics of biological phenomena. To overcome this issue, we conduct the study on development of a high speed and high performance imaging system for the dynamical imaging. We also reveal what can be observed by bio-imaging in the nervous system. With the advancement of this research, it seems possible not only to contribute to the development of basic research in biology, but also to apply the development as an imaging system that can capture various fast phenomena.

Concept Invention for Next Generation Power Semiconductor Devices UNIT

Project Leader

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Project Outline

This unit examines GaN power devices and concepts of next-generation power semiconductor devices in each respective application area, through material properties and market analysis/future prediction. First, this unit clarifies the performance required for meeting the needs of the power device market, to be applied to seed technologies, including device development. Next, device simulation is conducted to examine/verify device concepts; results are to be applied to creation of crystals and devices.

Smart Integrated Sensing System UNIT

Project Leader

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Project Outline

Ubiquitous gas sensing systems of high function are to be developed in order to advance smart integrated sensing systems that are applicable to environmental management and medicine. Such high functions include ultrasensitive detection, low power consumption driving, detection of gas molecules and remote sensing, using carbon nanotubes as core sensing materials. Research into next-generation sensing device systems is conducted to improve the S/N ratio with analog signal processing technologies and to create sensing devices based on small electromechanical system technologies.

Simulation Technology for Electronic Devices Innovation UNIT

Project Leader

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Project Outline

This unit focuses on simulation technologies for next-generation high power/ultrafast devices. In order to meet specifications required for next-generation electronic devices, it is essential to find the optimal solution from an enormous number of options in choosing materials, device structures, and circuit design. A primary goal of the project is to develop and integrate the following four technologies: band-structure calculation/material selection technologies based on the first principles method; transient response modeling technologies; high-field transport simulation technologies; and compact modeling technologies.

Terahertz Sensing and Imaging Systems UNIT

Project Leader

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Project Outline

Recently, sensing and imaging technologies using terahertz waves have been garnering great attention. This unit seeks to pioneer new industrial application areas by promoting various device developments between cooperative groups and by constructing terahertz sensing and imaging systems through efficient integration of these devices. The development of various devices includes optical sources such as quantum cascade laser and nonlinear optical crystals, and includes detector sensors such as superconducting Josephson detectors and InGaAs photoconductive switches.

Advanced Photonic Devices for New-Generation Communication Networks UNIT

Project Leader

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Project Outline

Development of advanced photonic devices for photonic nodes and gateways is necessary urgently for new-generation communication networks. However, there is considerable communication gaps between network designers and device engineers, and they often prevent efficient developments. This unit breaks such a closed situation through cooperation of four laboratories in the Division of Electrical, Electronic and Information Engineering, and develops advanced photonic devices optimized from various viewpoints of such a variety of researchers.

Plasma Photonic Device Generating High Luminescent Electromagnetic Radiation Toward Diagnostics of Electronic Device Material UNIT

Project Leader

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Supervisor

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Project Outline

By controlling high energy density field, which can be generated by ultrahigh intensity laser, with plasma photonic devices, and by developing efficient small electromagnetic sources covering a wide wavelength range, including terahertz and X-ray, this unit explores possibilities for diagnostics of electronic device materials using such electromagnetic sources. This research unit comprises domestic and international research institutes that are involved in laser-produced plasma research and comprises researchers involved in electronic device diagnosis using electromagnetic waves.

Exploration of New Materials toward Innovative Electronic Devices UNIT

Project Leader

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Project Outline

This IDER unit aims to generate new material enabling to drive the development of novel electronic device. Using dynamic high-pressure techniques based on high-power laser, we are exploring never-seen-before metallic phases of semiconductor and insulator material. Physics relevant to the pressure unloading process are investigated to quench the high-pressure phase under standard pressure and temperature. Additionally, these knowledge and techniques should be applicable to new material processing technology as laser-based noncontact surface/interior modification.

High Quality HTS-SQUID by Improvement of GB Junction Properties UNIT

Project Leader

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Project Outline

A superconducting quantum interference device (SQUID) is an ultrasensitive magnetic sensor constructed from superconducting rings and Josephson junctions. This unit evaluates defective portions of the crystal grain boundary of the Josephson junction, which determines SQUID sensitivity characteristics, in order to establish a process for significantly improving the imperfections. Through this process, the aim is to realize high performance terahertz detectors and new highly integrated SQUID measurement systems.

Advanced High-Performance Organic Photovoltaic Device UNIT

Project Leader

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Project Outline

This unit seeks to clarify basic properties of organic photovoltaic devices and to apply photovoltaic conversion devices. The particular purpose is to establish fabrication technologies that control organic nanostructure below exciton diffusion length, and to develop fabrication technologies for highly oriented/microcrystal structures of the donor layer and the acceptor layer in finely interpenetrated laminated structures. Also intended are considerable improvement of photovoltaic conversion efficiency and creation of next-generation organic photovoltaic devices.

Advanced Optical Electrical Interface UNIT

Project Leader

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Project Outline

This unit develops an advanced optical electrical (OE) interface on the basis of a fusion of the needs, seeds and ideas of researchers in optics, photonics and electronic device fields. Mainly we focus on a development of a highly-sensitive measurement system for high speed electrical signals based on an electro-optic sampling technique and we apply it to the characterization of the main part of the OE interface. We aim to contribute to the progress of ultrafast electronic devices, millimeter-wave devices and ultrafast electrooptic devices through the developed OE interface.

Concept Invention for Next Generation Power Semiconductor Devices UNIT

Project Leader

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Project Outline

Great interest has been directed towards organic crystals as high-efficient optical/electronic devices. However, producing high-quality organic single crystals is difficult in many cases. In this unit, we use organic-semiconductor material rubrene and attempt to develop growth techniques of high-quality crystals in solution-growth process. We apply solution stirring method and Laser Irradiated GrowtH Technique (LIGHT), which are used for high quality crystal growth of biomacromolecule, to rubrene crystallization. Furthermore, we investigate the mechanism of high-quality-crystal growth by using these techniques in organic-crystal-growth process. As a tool for the investigation, we construct a new observation system with high resolution on AFM. and observe growth process directly at the molecular level.