Division of Integrated Research

Research Division Introduction

The Division of Integrated Research, which is one of the divisions of the Organization for Advanced and Integrated Research at Kobe University, was reorganized in 2016 aiming at promotion of Kobe University's interdisciplinary flagship research approach, or advanced research and integrated study of both the humanities and sciences. World-class six research projects are driven at present.

Projects

№	Research Theme	Project Leader
01	Integrated Bio-Refinery Research Project	KONDO Akihiko
02	Research Project for Membrane Technology	MATSUYAMA Hideto
05	International Education and Research Center for Planetary Science	MAKINO Junichiro
06	Study on Next Generation Subsurface Imaging System	KIMURA Kenjiro
07	Creative Research for Multi-Scale Computational Biology	KONDO Akihiko
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Integrated Bio-Refinery Research Project

Project Leader   KONDO Akihiko

~Outline of Research Project~

In order to construct a sustainable post-petrochemical society, it is crucial to establish a bio-refinery process in which a number of materials including bio-fuel, bioplastics, and biofine chemicals are produced from biomass using low environmental impact technologies.

By uniting the disciplines of agriculture and engineering, this project aims at establishing a comprehensive bio-refinery system which encompasses development and assessment of biomass raw materials, pretreatment, biomanufacturing, production of materials and separation on the basis of university-industry collaboration.

Research Project for Membrane Technology

Project Leader   MATSUYAMA Hideto

~Outline of Research Project~

This project aims at developing a CO_2-selective separation membrane which can be applied to gas purification processing in high pressure environments such as: pre-combustion fuel gas for a next-generation coal gastification power plants, the demand for which is expected to increase, and purification of natural gas, which is a primary energy source with low CO_2 emissions.

Membrane separation technology has recently drawn attention as a compact process that realizes higher volumetric efficiency compared with the absorption process. The technology of membrane separation which can be used for CO_2 separation in high pressure environments will be expected to solve all the problems of conventional CO_2 separation systems. This research focuses on the development of a carrier which is highly reactive to CO_2 in high pressure environments and a polymer gel which guarantees high mechanical strength of the membrane. The combination of these two technologies will create a next-generation CO_2-selective separation membrane, the first membrane of its kind in the world.

International Education and Research Center for Planetary Science

Project Leader   MAKINO Junichiro

～Outline of Research Project～

Center for Planetary Science (CPS) is a research institute of Graduate School of Science, Kobe University, whose purpose is to contribute the development of planetary science through providing opportunities for collaborative activities of research and education by promoting active exchanges of students, researchers and academic knowledge of the related fields.

① Computational Planetary Science: Our aim is to elucidate the origin and evolution of planetary systems and the structure and change of planetary interiors and environments that are impossible to be experimentally explored in the laboratory through large-scale numerical simulations using supercomputers such as the K computer and the post-K computer (Fugaku).

② Consortium for Solar System Exploration: We are proposing the "Consortium for Solar System Exploration" by the cooperation with the planetary science community in Japan, to develop an infrastructure for planning and creating space missions and developing human resources to carry those future missions.

③ Research Exchange: We promote lectures by the top-level scientists of the world and prepare a field for human exchanges to create strong ties among researchers and students of the various fields of planetary science. We also give assistance in hosting seminars, schools and practical training courses in Japan.

④ Digital Library and Archives: We accumulate up-to-date and comprehensive knowledge acquired through those CPS's activities and provide it on our webserver to the world for the use of educational and academic purposes.

Study on Next Generation Subsurface Imaging System

Project Leader　KIMURA Kenjiro

～Outline of Research Project～

We applied the world's first Subsurface Imaging System, which we have been developing, to non-destructive imaging inspection of cutting-edge electronic components, infrastructure inspection for the Tokyo Olympics, and medical imaging diagnosis such as breast cancer diagnosis. Based on the three pillars, "Theoretical research", "Study of equipment technology for practical use", and "Practical research that actively incorporates users to the research team as needed", the purpose is to actively penetrate the society widely, using industry-academia collaboration as an accelerator.

Creative Research for Multi-Scale Computational Biology

Project Leader　KONDO Akihiko

～Outline of Research Project～

The goal of this project is to create multi-scale computational biology by integrating theory-driven and data-driven computational analyses of atoms, molecules, and cells. We aim to use the project results for the efficient production of bioenergy and high value-added chemicals in order to realize a low-carbon society. In addition, we hope this project will aid efficient pharmaceutical bio-production which will contribute to the health and longevity of society.

Research Project on Simulation Models of Neural Networks

Project Leader　OMORI Toshiaki

～Outline of Research Project～

Using the supercomputer π-computer, this project aims to elucidate information processing in the brain and to study its applicability to medical engineering by using computational models of neurons and neuronal networks based on neurophysiology. NEURON is a modeling system developed at Yale University and Duke University, and the NEURON simulation environment was installed on the π-Computer in collaboration with San Diego Supercomputer Center at the University of California, San Diego, and its potential applications and computational performance are being evaluated.

The research uses computational models to find links between information processing in the brain, the structure of neuronal networks, and the effects of an extracellular electrical field on information processing of neurons. Furthermore, we are also exploring its potential applicability to medical engineering and data-driven approaches for extracting mathematical models of neural systems from neural activities observed as brain imaging data.