Research area in Strategic Objective *"Materials Science for desirable Selection — Constructing new principles toward a sustainable development society"*

Creation of innovative and integrated technologies for materials development and circular processes and development of their scientific basis.

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Overview

This research area focuses on the sustainability of materials and substances among the global environmental and resource issues and aims to create innovative basic technologies by integrating materials development research and recycling process research, as well as to establish the scientific basis for such technologies.

Specifically, they are as follows.

In material development research, we explore the use of less resource-constrained materials or recycled materials that can be reused in the future. We seek to establish design guidelines for recyclable materials that balance the need for functionality at the time of use and recycling at the end of life. For instance, we are expecting to develop technologies to create desired new materials and products from used materials and products without going through the separation and recovery process, or within the separation and recovery process.

In recycling process research, we are aiming to establish technologies that enable a large and stable supply of recycled materials that satisfy the performance and functions required for material creation, as well as selective and efficient separation and recovery technologies that can address the requirements (price, safety, etc.) necessary for material production in terms of social acceptance.

As many materials currently on the market are composite or complex to provide their functions, we also expect to see efforts to develop technologies to evaluate, measure and analyze control factors such as their internal structures and interfaces from multiple viewpoints to facilitate their recycling. By coupling the above two researches, we will encourage research aimed at the establishment of a resource recycling system.

It is also important to systematize these findings as new scientific principles. This will contribute to the realization of a sustainable society. Therefore, we want to communicate the new scientific

principles developed in this research area worldwide and expect fundamental and academic research results that can be published in prestigious journals.

Research Supervisor's Policy on Call for Application, Selection, and Management of the Research Area

1. Background

We have a comfortable and functional life, supported by the mass production and consumption of functional materials. Meanwhile, there is a growing movement to increase the use of recycled materials and limit the use of hazardous materials as environmental concerns such as greenhouse gas emissions (such as CO2), spills of hazardous materials, and ocean plastics become more apparent. Another major challenge for Japan is the lack of resource reserves and concerns about resource security due to geopolitical issues. To solve these issues, it is desirable to integrate material development and recycling processes from the initial stage of investigation and to establish fundamental technologies to satisfy social requirements, such as upcycling to improve physical properties during the recycling, tailoring design to enable selection of desired properties, and resourcing to enable recycling as a system. In such situations, there are high demands for fundamental technologies for materials development that can demonstrate performance comparable to or superior to existing materials and products, using resources that have not been focused on in the past, as well as recycled resources from materials and products that have been incinerated or disposed of in landfills. This includes the development of safe and ecologically compatible materials and products, the development of manufacturing processes for these materials and products in response to environmental and resource constraints, and the development of separation and recovery methods and processes for recycled resources suitable for use in the manufacture of these materials and products. Therefore, in conjunction with researchers involved in materials development and recycling technologies, it is important to communicate and collaborate with related researchers in measurement, evaluation, and prediction of these technologies to understand the cycle.

Therefore, we seek to develop a new academic field by incorporating issues derived from these societal concerns into fundamental studies and working to solve them through communication and collaboration between both the material development researcher and the recycling process scientist.

2. Recruitment and Selection Policy

(1) Fundamental Policy

In this area, we will support basic research aimed at improving the recyclability of materials and substances by addressing societal demands in terms of environmental and resource constraints. Our research interests include metallic, inorganic, organic, and polymeric materials and their composites, as well as products made from these materials. Our research covers a wide range of fields, including materials and chemistry, environment and energy, biotechnology, mechanical engineering, electronics, nuclear energy, geology and oceanography, and social sciences. The proposals should not be a mere extension or improvement of research being conducted by existing similar programs, but should be novel in concept, challenging a new academic field, and highly academic in nature, with the expectation that the results will be published in a journal with a significant international presence. It is also important to actively protect research results originating in Japan as intellectual property. To the extent possible, please also indicate your IP strategy in your proposal.

(2) Expected Research Contents

The design of materials and systems/processes for separation, decomposition and recovery methods with a view to the entire resource cycle is important in this area. In the design of materials for recyclability, scientific research should be conducted not only from the point of view of materials development, but also from the point of view of recycling. In the separation, decomposition, and recovery methods, it is desirable to be able to provide recycled materials in an optimal form for materials development. Examples of each of these methods are listed below, but we expect creativity and fresh ideas in proposals.

A. Research and development of materials

a. Developing functional, high-performance materials that overcome environmental and resource constraints.

Research is aimed at developing new materials with properties that are equivalent or superior to those of materials that have properties due to their complex composition or structure, or due to the use of rare elements (e.g., laminated films, lithium batteries, structural materials, various composite materials, etc.), or materials that have been identified as having safety issues or environmental impacts (e.g., fluoropolymers, lead products, general purpose plastics, etc.), and that are recyclable or biodegradable to the extent possible.

b. Developing materials with low environmental impact and recyclable properties from recycled materials.

Research seeks to understand the characteristics of recycled materials, many of which have different properties than high-purity materials, such as impurities and mixtures, and to develop novel materials that take advantage of these properties as well as low environmental impact and recyclability.

c. Development of new materials from recycled materials and products.

Research objectives are to develop new materials from waste materials or products without or with minimized separation, disassembly and recovery processes.

B. Research for recycling process

The goal of the research is to develop a method of supplying recycled materials that is optimized in accordance with the intentions of the material development researchers, and to develop a high-efficiency or high-speed process (including various technologies such as material recycling and chemical recycling) in consideration of its economic efficiency.

(3) Organizations for research implementation

CREST is a team-based research program, and we ask that the best research team from industry, academia, and government be organized to carry out a challenging research concept formulated by the Principal Investigator at an internationally high level. Please note that the composition of the team should be essential for the achievement of the concept and that the team should be sufficiently collaborative to make a significant contribution to the achievement of the research objectives. Collaboration between materials development researchers and recycling process researchers is important. If collaboration between the two is difficult at the time of the proposal, please describe your future collaborative approach in your proposal. If it is recognized that collaboration with research areas other than the one proposed would be useful in achieving the research objectives, the research director may request changes to the research plan, such as encouraging collaborative research or revising the team structure, after the decision to accept the proposal has been made.

(4) Selection policies

a. The social needs to be solved must be clearly presented and a clear roadmap for solving them must be drawn.

b. The proposal must include new ideas that are not simply extensions of conventional technologies in existing programs or your own research initiatives.

c. The materials and technologies to be researched should be proposed from both the materials development and recycling process perspectives.

d. The proposal should be research of high academic value that can be published in a journal with a high international prestige and that is expected to establish a new academic field.

3. Research periods and research funds

The total research budget is limited to a maximum of 300 million yen (direct costs) per proposal. The research period is 5.5 years or less.

4. Principle of research-area management

In order to maximize the results of the research area as a whole, networking will be promoted through information exchange and collaboration among researchers in different teams (including individual researchers in PRESTO research areas under the same strategic goal), research area advisors, industry, and other researchers inside and outside the research area. When the research has started and the environment for conducting CREST research has been established, we will visit each laboratory to confirm the research environment and to follow up on the details of the research plan. A meeting is held once or twice a year to monitor the progress of each team and to exchange information within the research area. An interim evaluation will be conducted after three years of research, and a post-evaluation will be conducted in the final year. In addition, international workshops and public symposiums will be held to disseminate the results of the research in the research area.