



**Title of Project : Materials Science and Advanced Electronics  
 Created by Singularity**

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Research Project Number : 16H06413    Researcher Number : 50282570

**【Purpose of the Research Project】**

Crystalline materials comprise periodically arranged atoms. Traditionally, any disorders found in crystals have been regarded as structural defects that ought to be eliminated from the materials. Recent progress in solid-state electronics, which has led to the explosive development of the information society, is in fact based on the crystallography and physics of these perfect crystals. However, our “singularity-structure project” is trying to introduce a Copernican revolution in this notion: it aims to focus on imperfect crystals which contain intentionally introduced defects. We are trying to understand the basic characteristics of the defects embedded in perfect crystals, which we define as “singularity structures.” We would like to lay the foundations for a new discipline within crystallography and for the physics related to crystals with imperfection. Furthermore, we will try to fabricate functional electronic devices—that cannot be achieved with conventional perfect crystals—by having these devices take advantage of the versatile physical properties of singularity structures.

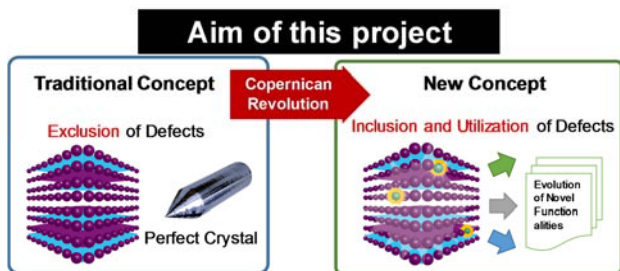


Figure 1 Basic concept of this project.

**【Content of the Research Project】**

This project covers various research topics such as the preparation/characterization of singularity structures, device fabrication with singularity structures, and theory for new crystallography and physics for singularity structures. This study will necessitate close collaboration among scientists from various fields, such as electrical engineering, chemistry, and theoretical/experimental physics. The work on the project will be divided into four areas:

A01: Crystal growth and construction of extended crystallography,

A02: Processing and application for novel electronics,

B01: Structural characterization of defects and their properties,

B02: Optical characterization of defects and their properties.

In addition to our own research plans, we intend to incorporate innovative ideas from young researchers by collecting their plans on all topics related to singularity structures.

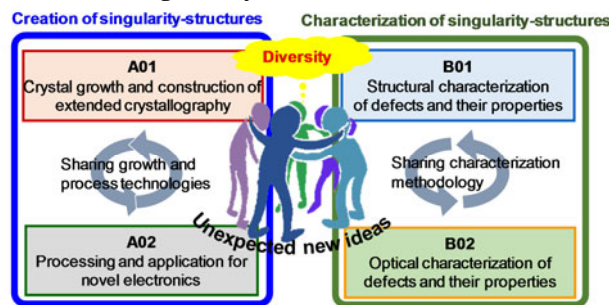


Figure 2 Organization chart of this project.

**【Expected Research Achievements and Scientific Significance】**

At the end of this project, our achievements will make obsolete the notion that perfect crystals are the best materials for crystallography; furthermore, we will explain that crystals with defects are the treasure houses of new functionalities. We expect singularity structures to not only be applied to conventional applications, such as lighting, communication, data processing, power control, and energy generation, but also to new fields such as agriculture, medicine, pharmacy, and chemical synthesis.

**【Key Words】**

**Perfect crystal** : Crystals that comprise in perfectly periodically-aligned atoms.

**Singularity crystal** : Imperfect crystals which contain intentionally introduced defects.

**【Term of Project】**      FY2016-2020

**【Budget Allocation】**    1,103,800 Thousand Yen

**【Homepage Address and Other Contact Information】**

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