



**Title of Project : Precise Formation of a Catalyst Having a Specified Field for Use in Extremely Difficult Substrate Conversion Reactions**

Kazushi Mashima  
(Osaka University, Graduate School of Engineering Science,  
Professor)

Research Project Number : 15H05795 Researcher Number : 70159143

**【Purpose of the Research Project】**

Synthetic organic chemistry is a fundamental science and technology that supports material sciences, such as drug development, polymer science, etc., by providing practical and efficient synthetic methods for the preparation of useful organic compounds. Organic chemists are expected to contribute not only to innovating and developing more practical and environmentally benign synthetic protocols but also to creating new compounds with higher functionalities or biological activities. For this purpose, development of new catalysts should play a key role, and the ultimate object of this program is to realize the precise formation of a catalyst with a specific scaffold to bring about innovation in this research field. Accordingly, this project is directed toward generating new catalysts with specific reactive fields that effectively enable extremely difficult substrate conversions. Examples of target reactions are direct functionalization of easily available hydrocarbons; direct conversion of CO<sub>2</sub>, O<sub>2</sub>, and N<sub>2</sub> into useful organic molecules; clean reactions without waste; and so on. As shown in Figure 1, a new research area – “Precisely Designed Catalysts with Customized Scaffolding” – will be developed by designing a catalytically active site surrounded by carefully designed scaffolds that enable control of reactivity and selectivity, activation of substrates, etc.

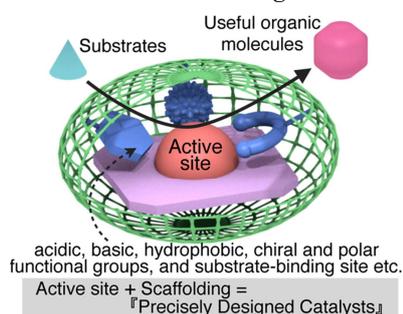


Fig 1. Strategy for Precisely Designed Catalysts.

**【Content of the Research Project】**

In this research area, as shown in Figure 2, the following four research items cooperatively collaborate with each other to introduce innovation in the field of catalytic synthetic organic chemistry. Intensive studies will be performed to install the appropriate functions of suitable steric and electronic properties into a specific field around a catalytically active site.

Research Item A01: Development of Extremely Difficult Substrate Conversion; Research Item A02: Precise Formation of Transition Metal Catalysts with Molecular Scaffolding; Research Item A03: Precise Formation of Catalysts with Biomolecular Scaffolding; Research Item A04: Precise Formation of Catalysts with Large Scale Molecular Scaffolding.

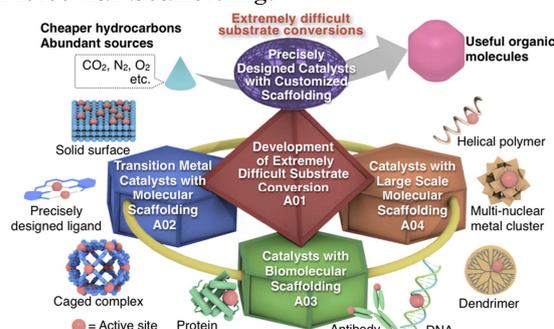


Fig 2. Concepts of Precisely Designed Catalysts with Customized Scaffolding and the Four Cooperatively-collaborating Research Items.

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

The creation of new catalysts with a specific field will open up new "synthetic organic chemistry", leading to the renovation of synthetic methodologies in industry and contributing to the realization of a sustainable society.

**【Key Words】**

**Catalyst Having a Specified Field:** A catalyst with a highly active site surrounded by various reactivity-controlling groups.

**Extremely Difficult Substrate Conversion Reactions:** Typical examples are direct functionalization of hydrocarbons; direct conversion of CO<sub>2</sub>, O<sub>2</sub>, and N<sub>2</sub> into useful organic molecules; and clean reactions without waste.

**【Term of Project】** FY2015-2019

**【Budget Allocation】** 1,221,200 Thousand Yen

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

<http://precisely-designed-catalyst.jp/>  
mashima@chem.es.osaka-u.ac.jp