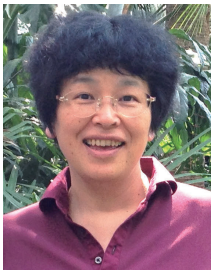
【Grant-in-Aid for Scientific Research (S)】

Broad Section E



Title of Project : Catalytic Bond-Cleavage Reactions toward Utilization of Renewable Resources

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Research Project Number : 18H05259 Researcher Number : 60222197
Keyword : Renewable resources, Catalyst, Reduction, Bond-cleavage, Metal–ligand cooperative effect

【Purpose and Background of the Research】

The chemical industry has developed a method of converting exhaustible fossil resources into various useful substances. Synthetic chemistry is the major stream, that assembles simple constituents such as C2~5 fractions and BTX (benzene · toluene · xylenes) given by cracking naphtha obtained from petroleum. Also, most of the conventional chemical processes are oxidation of these highly reduced carbon compounds.

On the other hand, different methodology will be needed for utilization of biomass such as lignin and grease, which are renewable carbon resources. Since the carbon atoms in renewables are often highly oxidized, it is necessary to reduce the carbon atoms for the effective utilization of them. Furthermore, as renewable resources are often mixtures of complex compounds, "decomposition chemistry" need to be considered in order to convert the macromolecules into small molecules for easy handling.

This research aims to develop catalytic bond-cleavage reactions, which are necessary when considering effective use of renewable carbon resources.

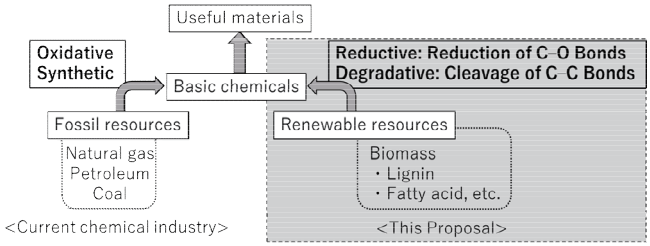

Figure 1. The purpose of this research.

【Research Methods】

1. Reductive cleavage of C–O bonds in the reduction of highly oxidized resources: Especially toward the synthesis of aromatic hydrocarbons and their analogues from lignin, we aim to develop selective hydrogenolysis catalyst of C–O bond in phenol and aryl methyl ether which are commonly found in the partial structure of lignin.

2. Cleavage of C–C bonds contributing to decomposition of complex structures: Toward utilization of aliphatic carboxylic acids, we focus on the decarboxylation–dehydrogenation of aliphatic carboxylic acids. The dehydrogenation–decarbonylation from aliphatic alcohols and aldehydes will be also examined. In addition, the dehydrogenation–retro-aldol reaction of a 1,3-diol structure, a partial structure of lignin, will be also investigated. These findings will pave the avenue of basic science toward the production of basic chemicals from renewable resources.

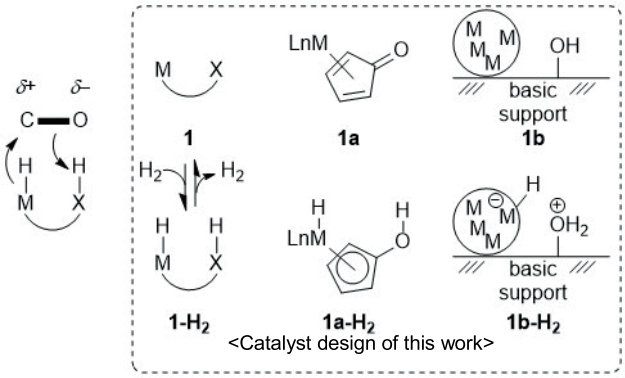

Figure 2. Approach of this study.

【Expected Research Achievements and Scientific Significance】

The concept of catalytic design in homogeneous catalysis will be expanded to heterogeneous systems. The success of this research opens up a new field of "decomposition chemistry".

【Publications Relevant to the Project】

・Direct and Selective Hydrogenolysis of Arenols and Aryl Methyl Ethers. S. Kusumoto, K. Nozaki *Nat. Commun.*, **2015**, *6*, 6296.
・The Retro-Hydroformylation Reaction. S. Kusumoto, T. Tatsuki, K. Nozaki *Angew. Chem. Int. Ed.* **2015**, *54*, 8458.

【Term of Project】 FY2018-2022

【Budget Allocation】 147,900 Thousand Yen

【Homepage Address and Other Contact Information】

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