Abstract

[Project Information]

Project Title :	Innovative Molecular Catalytic Technology for Precise Molecular Transformation that Enables Carbon Resource Recycling
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[Abstract]

In order to construct a sustainable society, it is necessary to build industries that can completely recycle the carbon resources. Consequently, there is an imperative to establish a technology capable of efficiently converting carbon resources, particularly renewable carbon resources such as biomass and carbon dioxide, as well as natural gas resources which are currently primarily utilized as heat sources, into fundamental chemical products suitable for application in the chemical industry. In this study, we employed molecular organometallic complex catalysts to address three issues: the production of low-molecular-weight basic aromatic compounds through the degradation of modified lignin, the production of useful basic chemical products through the functionalization of simple hydrocarbons, and the production of carboxylic acid derivatives through the conversion of carbon dioxide. In the context of lignin degradation, the iridium-catalyzed reaction of modified lignin in a polyethylene glycol solvent under a hydrogen atmosphere has been demonstrated to be a highly efficient procedure. The suppression of insolubilization by reversible modification of hydroxy groups in lignin proved to be a pivotal factor in enhancing the reaction efficiency. In regard to the functionalization of simple hydrocarbons, a study was conducted on the subject of dehydrogenation reactions involving a variety of cyclopentadienone iridium complexes. Consequently, we have achieved the development of catalytic dehydrogenation of simple hydrocarbon compounds and remote unsaturation of cycloalkanones, which enables the functionalization of distal position from the carbonyl group. Furthermore, the development and application of cyclopentadienone complexes with group 5 metals, such as vanadium and tantalum, has been undertaken for the purpose of studying the transfer dehydrogenation of alcohols. In the context of carbon dioxide fixation, the poly carbone ligands bearing multiple carbone moieties, zero-valent carbon ligands, has been developed. These ligands have been utilized in the construction of complexes with highly electron rich elemental

species. An extremely electron-rich copper centers was enabled by combining copper precursor and bis(carbodiphosphorane) ligand. In addition, a distorted dicationic boron center was found to be stabilized by utilizing the biscarbone ligand developed in this study. These results of the study and the developed reactions for various molecular transformations are expected to contribute to enable the construction of sustainable society.

[References]

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