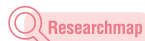
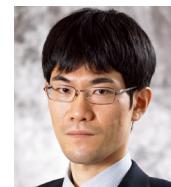


Palladium-catalyzed skeletal rearrangement of cyclobutanones

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Abstract

Organic compounds, such as pharmaceuticals, plastics, and pigments, support our lives. Synthesis of desired organic compounds is typically performed by sequentially transforming a part of readily available starting materials. In contrast, if the carbon-carbon bonds constructing the framework of organic compounds can be transformed into other functional groups, completely different molecular frameworks can be synthesized in one step. In this study, we developed the palladium-catalyzed skeletal rearrangement of cyclobutanones, leading to the formation of 1-indanones.

Background & Results

Catalytic transformation of carbon-carbon bonds has the potential to provide a chemical technology to realize a society based on carbon cycling. Transition metal-catalyzed carbon-carbon bond cleavage has been studied for a long time. However, the development of new catalysts is still required because the scope of carbon-carbon bonds for this approach is limited. We developed the palladium-catalyzed skeletal reorganization of cyclobutanones into 1-indanones via the dual cleavage of carbon-carbon and carbon-hydrogen bonds. Although catalytic transformation of cyclobutanones into 1-indanones has been reported, the introduction of reactive functional groups or directing groups is needed to perform the reaction successfully. In contrast, our method can perform the direct transformation of simple cyclobutanones into 1-indanones.

Screening of reaction conditions revealed that the use of an N-heterocyclic carbene (NHC) ligand is effective, leading to the desired skeletal rearrangement of 3-arylcyclobutanone. A variety of functional groups such as nitro, ether, cyano, and fluorine groups are compatible under the reaction conditions. The reaction of a spiro-type cyclobutanone afforded a polycyclic ketone in good yield. When the reaction was conducted in the presence of nucleophiles such as alcohols, amines, and arylboronates, giving the corresponding ring-opening products.

Significance of the research and Future perspective

This report demonstrated the new reactivity of a Pd(0)/NHC complex that can serve to activate inert carbon-carbon and carbon-hydrogen bonds without the assistance of "foothold" functional groups. This would contribute to the development of new methods for the step-economical organic synthesis. Further research regarding the skeletal rearrangement and editing of organic compounds will also be promoted by this research, serving pharmaceutical and agrochemical research and development.

General Strategy in Organic Synthesis



Strategy through the Carbon-Carbon Bond Cleavage

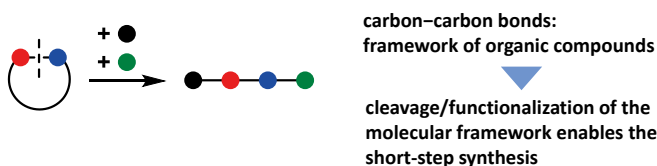


Figure1

Overview

Palladium-catalyzed skeletal rearrangement via the cleavage of carbon-carbon and carbon-hydrogen bonds is developed.

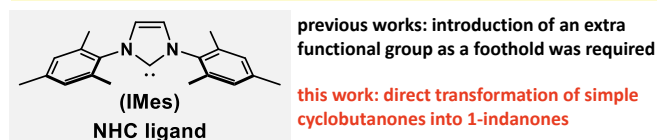
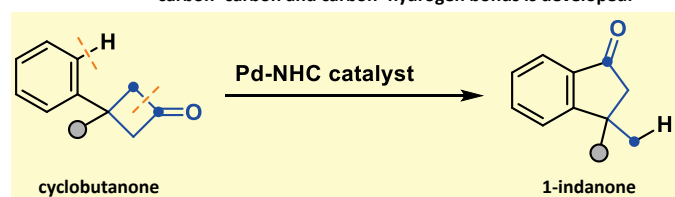


Figure2

Scope of the Reaction

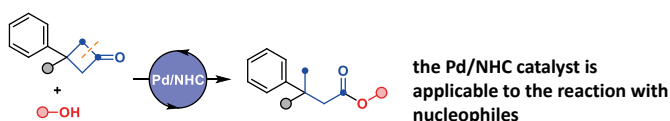
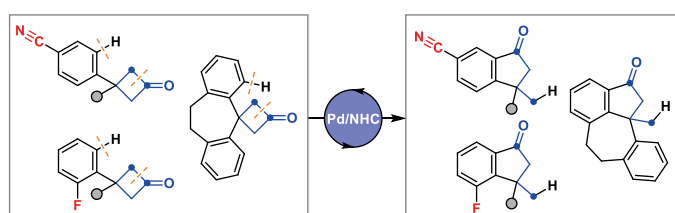


Figure3

Patent

Treatise

URL

Keyword

Ano, Yusuke; Takahashi, Daichi; Chatani, Naoto et al. Palladium-catalyzed skeletal rearrangement of cyclobutanones via C-H and C-C bond cleavage. ACS Catalysis 2023, 13(4), 2234–2239. doi: 10.1021/acscatal.2c06389

palladium catalyst, cyclobutanones, skeletal rearrangement