

# Development of Novel Efficient Palladium-Catalyzed Carbonylation Reactions in Combination with Copper Salts

著者	ファン ティ ハン ガー
著者別表示	Phan Thi Hang Nga
journal or publication title	博士論文要旨Abstractおよび要約Outline
学位授与番号	13301甲第4727号
学位名	博士（理学）
学位授与年月日	2018-03-22
URL	<a href="http://hdl.handle.net/2297/00051429">http://hdl.handle.net/2297/00051429</a>

doi: <http://dx.doi.org/10.1246/cl.160804>



# 学位論文概要

## Dissertation Summary

(Title) Development of Novel Efficient Palladium-Catalyzed Carbonylation Reactions in Combination with Copper Salts

(Title in Japanese) 新規かつ効率的な銅塩協働パラジウム触媒によるカルボニル化反応の開発

Division: Material Chemistry

Student ID Number: 1524022003

Name: Phan Thi Hang Nga

Chief supervisor: Yutaka Ukaji

The development of sustainable and efficient methodologies based on catalysis and organometallic chemistry has gained considerable attention. In this regard, palladium-catalyzed carbonylation reaction of olefins are now widely recognized as a versatile method for the functionalization of C=C double bond to produce a variety of useful homologated carbonyl compounds utilizing carbon monoxide (CO) as an inexpensive and readily available C1 unit, which also meets the principles of “atom economy”, “step economy”, and “green chemistry”. The great synthetic value of these carbonylation reactions has attracted broad interest from both academic and industrial researchers.

Although considerable contributions have been made in this rapidly developing area, challenges still remain for further investigations. Particularly, asymmetric palladium-catalyzed carbonylations of alkenes have undeveloped and still been regarded as the most challenging problem in carbonylation field. Furthermore, the intermolecular version of the alkoxy-carbonylation of alkenes is quite limited. Development of catalytic system with higher efficiency, stereoselectivity, and larger substrate scope is an important issue for these transformations.

On the basis of earlier works in our laboratory, the combination of palladium(II) with copper(I) salt has realized to catalyze alkoxy-carbonylations and related reactions under normal pressure of carbon monoxide and oxygen. The task of the present study was decided to develop novel efficient palladium-catalyzed carbonylation reactions in the presence of copper salts. This research consists of two main contents:

1) Asymmetric Palladium-Catalyzed Intra- and Intermolecular Dicarboxylation of Homoallylic Amine Derivatives

Asymmetric intra- and intermolecular dicarboxylation reaction of homoallylic amine derivatives catalyzed by palladium(II) and copper(I) salt under normal pressure of CO and O<sub>2</sub> has been achieved by using a chiral bioxazoline ligand. A variety of *N*-substituted homoallylic amine derivatives was applicable to the present reaction to give the corresponding optically active  $\gamma$ -lactams up to 68% ee. Thus, this method provides a new synthetic entry for the direct construction of optically active  $\gamma$ -lactams, which have biological activity and are useful building blocks for nitrogen-containing chemicals.

2) Palladium-Catalyzed Intermolecular Alkoxy-Alkoxy-carbonylation of Vinylphenols in the Presence of Copper Salt: Unexpected Cooperative Effect of Tin Salt

The efficient palladium-catalyzed intermolecular alkoxy-alkoxy-carbonylation of vinylphenols in the presence of copper and tin salts was developed to afford the corresponding 3-alkoxy-3-arylpropanoic acid esters in good to high yields. In this work, an unexpected effect of tin salt was discovered. The presence of a tin salt was crucial to realize reproducibly high yields. It is noteworthy that the 3-alkoxy-3-(hydroxyphenyl)propanoic acid esters obtained by the present alkoxy-alkoxy-carbonylation could be versatile synthetic intermediates via further transformation to useful chemicals and bioactive agents.

To conclude, novel and efficient palladium-catalyzed carbonylation reactions have successfully developed. The combination of palladium(II) and copper(I) salt catalyzed these reactions under mild conditions. Notably, the methods developed from this research could find great interest in the synthesis of highly functionalized molecules and especially in the synthesis of biologically active compounds.