

# The Chemical Transformations of C1 Compounds

3-Volume Set

Edited by

Xiao-Feng Wu, Buxing Han,  
Kuiling Ding and Zhongmin Liu



Chemistry | Organic Chemistry

## A comprehensive exploration of one-carbon molecule transformations

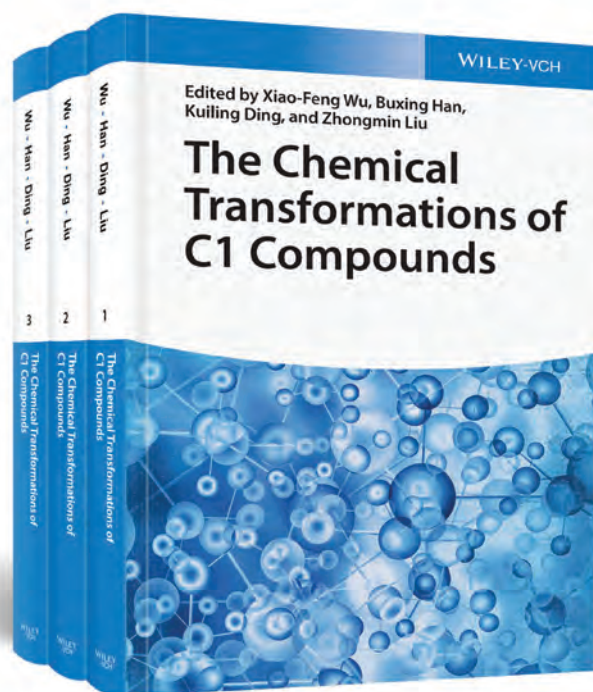
The chemistry of one-carbon molecules has recently gained significant prominence as the world transitions away from a petroleum-based economy to a more sustainable one. In *The Chemical Transformations of C1 Compounds*, an accomplished team of chemists delivers an in-depth overview of recent developments in the field of single-carbon chemistry. The three-volume book covers all major C1 sources, including carbon monoxide, carbon dioxide, methane, methanol, formic acid, formaldehyde, carbenes, C1 halides, and organometallics.

The editors have included resources discussing the main reactions and transformations into feedstock chemicals of each of the major C1 compounds reviewed in dedicated chapters. Readers will discover cutting-edge material on organic transformations with MeNO<sub>2</sub>, DMF, DCM, methyl organometallic reagents, CC1<sub>4</sub>, CHCl<sub>3</sub>, and CHBr<sub>3</sub>, as well as recent achievements in cyanation reactions via cross-coupling.

### The book also offers:

- Thorough introductions to chemical transformations of CH<sub>4</sub>, methods of CH<sub>4</sub> activation, chemical transformations of CH<sub>3</sub>OH and synthesis alkenes from CH<sub>3</sub>OH
- Comprehensive explorations of the carbonylation of MeOH, CH<sub>2</sub>O in organic synthesis, organic transformations of HCO<sub>2</sub>H, and hydrogen generation from HCO<sub>2</sub>H
- Practical discussions of the carbonylation of unsaturated bonds with heterogeneous and homogeneous catalysts, as well as the carbonylation of C(sp<sup>2</sup>)-X bonds and C(sp<sup>3</sup>)-X bonds
- In-depth examinations carbonylative C-H bond activation and radical carbonylation

Perfect for organic and catalytic chemists, *The Chemical Transformations of C1 Compounds* is also an ideal resource for industrial chemists, chemical engineers, and practitioners at energy supply companies.



3 Volumes | Print ISBN 9783527348954  
Hardcover | 1584 pages | February 2022  
List price US\$575.00



Please contact your local Wiley sales representative to place your orders or for any queries.

WILEY-VCH

# The Chemical Transformations of C1 Compounds

3-Volume Set

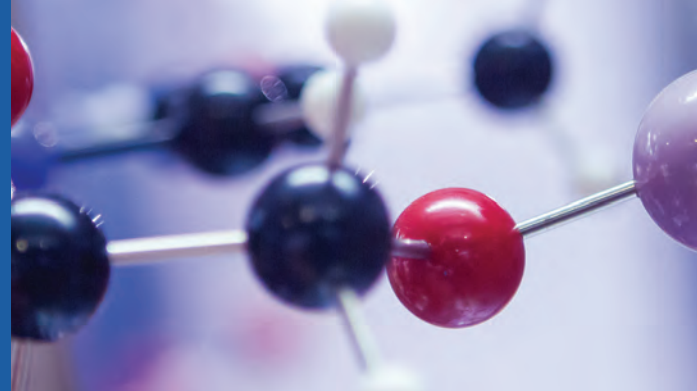


## TABLE OF CONTENTS

1. Direct Conversions of Methane via Homogeneous Processes  
*Zhiwei Zuo, Hui Chen, Anhua Hu, Liang Chang, Qing An & Hui Pan*
2. Chemical Transformations of Methanol  
*Xiao-Feng Wu & Zhengkai Chen*
3. Synthesis Alkenes from CH<sub>3</sub>OH  
*Zhongmin Liu, Wenna Zhang & Yingxu Wei*
4. Carbonylation of Methanol: A Versatile Reaction  
*Dipak Kumar Dutta*
5. Formaldehyde as C1 Synthon in Organic Synthesis  
*Xiao-Feng Wu & Wangfang Li*
6. Organic Transformations of HCO<sub>2</sub>H  
*Xiao-Feng Wu & Zhiping Yin*
7. The Multifunctional Materials for Heterogeneous Carboxylation: From Fundamental Understanding into Industrial Applications  
*Yunjie Ding, Li Yan & Xiangen Song*
8. Recent Hydrocarbonylation of Unsaturated Hydrocarbons with Homogeneous Catalyst  
*Kuilong Ding & Kaiwu Dong*
9. Carbonylation of C(sp<sup>2</sup>)-X bonds  
*Qiang Zhu, Huaanzi Hu & Jian Liu*
10. Carbonylation of C(sp<sup>3</sup>)-X bonds utilizing CO  
*Aiwen Lei & Renyi Shi*
11. Carbonylative C-H bond activation  
*Bruce A. Arndtsen & Angela Kaiser*
12. Recent Advances in Radical Carbonylation  
*Ilhyong Ryu, Shuhei Sumino & Takahide Fukuyama*
13. Asymmetric carbonylation reactions  
*Xumu Zhang, Shaotao Bai & Jialin Wen*
14. Carbonylative Synthesis of DPC (Diphenyl Carbonate)  
*Raffaella Mancuso & Bartolo Gabriele*
15. Oxidative Carbonylation of Amines  
*Chungu Xia, Yanwei Cao & Lin He*
16. Carbonylation of Nitroarenes and Related Compounds  
*Fabio Ragaini & Francesco Ferretti*
17. Zeolite-Catalyzed Carbonylation of Dimethyl Ether  
*Wenjie Shen, Ensheng Zhang & Zhiping Xiong*
18. Complex Natural Product Total Syntheses Facilitated by Palladium-Catalyzed Carbonylative Cyclizations  
*Mingji Dai, Yiyang Luo & Lei Li*
19. Metal-Catalyzed Alternating Polymerization Reactions with Carbon Monoxide  
*Werner Oberhauser*
20. CO Hydrogenation  
*Ye Wang, Jingting Hu, Wei Zhou, Kang Cheng & Qinghong Zhang*
21. Carboxylation with Carbon Dioxide as a C1 Source via Carbon-Carbon Bond Forming Reactions  
*Fujihara Tetsuaki*
22. Cyclization reactions with CO<sub>2</sub>  
*Arjan Kleij*
23. Reduction of CO<sub>2</sub> to Formic Acid  
*Buxing Han, Bernard Baffour Asare Bediako & Qingli Qian*
24. Reduction of CO<sub>2</sub> to CO and their Applications  
*Troels Skrydstrup, Karoline T. Neumann, Anne K. Ravn, Martin B. Johansen, Aske S. Donslund, Magnus H. Rønne & Haraldur G. Gudmundsson*
25. Hydrogenation of CO<sub>2</sub> to Chemicals with Green Hydrogen  
*Can Li, Feng Sha, Xinyi Liu, Shan Tang & Jijie Wang*
26. Methylation Reactions with CO<sub>2</sub>  
*Liang-Nian He, Xiang-Yang Yao, Zhi-Wen Yang & Hong-Ru Li*
27. Using CO<sub>2</sub> as -CH<sub>2</sub>- and -CH- Sources  
*Da-gang Yu, Xiao-Wang Chen, Yong-Yuan Gui, Yuan-Xu Jiang, Ke Jing, Ya-Nan Niu & Yue-Ming Jiang*
28. Catalytic Asymmetric Transformations of CO<sub>2</sub>  
*Yuehui Li, Fachao Yan & Jian-Fei Bai*
29. Polymerization Reactions with CO<sub>2</sub>  
*Xiao-bing Lu & Wen-Bing Li*
30. Transition Metal Catalyzed C-CN Cross-Coupling  
*Pazhamalai Anbarasan & Murugan Dhanalakshmi*
31. Recent Advancement in Transition-metal-catalyzed Hydrocyanation of Nonpolar Unsaturated Compounds  
*Kaiwu Dong, Rongrong Yu & Xianjie Fang*
32. Organic Transformations with MeNO<sub>2</sub>  
*Bhalchandra M. Bhanage, Debarati Das & Nilam Patil*
33. Applications of DMF as a Reagent in Organic Synthesis  
*Xiao-Feng Wu & Zechao Wang*
34. Advances in the Synthesis of Methylated Products Through Direct Approaches: A Guide for Selecting Methylation Reagents  
*Yantao Chen*
35. Organic Transformations with DCM, CCl<sub>4</sub>, CHCl<sub>3</sub>, and CHBr<sub>3</sub> and Other Related Reactions  
*Jieping Wan & Yunyun Liu*
36. Trifluoromethylation with CF<sub>3</sub>I and Other Related Reagents  
*Feng-Ling Qing & Xiu-Hua Xu*
37. The Applications of Dimethyl Sulfoxide as a One-carbon Source in Organic Synthesis  
*Xiao-Feng Wu & Chong-Liang Li*

# The Chemical Transformations of C1 Compounds

3-Volume Set



## LIST OF CONTRIBUTORS

### **Pazhamalai Anbarasan**

Department of Chemistry  
Indian Institute of Technology  
Madras  
Chennai, India

### **Bruce A. Arndtsen**

Department of Chemistry  
McGill University  
Montreal, Canada

### **Jian-Fei Bai**

State Key Laboratory for Oxo  
Synthesis and Selective Oxidation  
Suzhou Research Institute  
Lanzhou Institute of Chemical  
Physics  
Chinese Academy of Sciences  
Lanzhou, P. R. China

### **Bhalchandra M. Bhanage**

Department of Chemistry  
Institute of Chemical Technology  
Mumbai, India

### **Xiao-Wang Chen**

Key Laboratory of Green  
Chemistry & Technology of  
Ministry of Education  
College of Chemistry  
Sichuan University  
Chengdu, P. R. China

### **Yantao Chen**

AstraZeneca Innovative  
Medicines Cardiovascular and  
Metabolic Diseases  
Mölnådal, Sweden

### **Zhengkai Chen**

Department of Chemistry  
Zhejiang Sci-Tech University  
Hangzhou, P. R. China

### **Mingji Dai**

Department of Chemistry  
Center for Cancer Research  
Institute for Drug Discovery  
Purdue University  
West Lafayette, USA

### **Debarati Das**

Department of Chemistry  
Institute of Chemical Technology  
Mumbai, India

### **Murugan Dhanalakshmi**

Department of Chemistry  
Indian Institute of Technology  
Madras  
Chennai, India

### **Kuiling Ding**

Shanghai Jiao Tong University  
Shanghai, P. R. China

### **Yunjie Ding**

Dalian Institute of Chemical  
Physics  
Chinese Academy of Sciences  
Dalian, P. R. China

### **Kaiwu Dong**

Chang-Kung Chuang Institute  
Shanghai Key Laboratory of  
Green Chemistry and Chemical  
Process  
School of Chemistry and  
Molecular Engineering  
East China Normal University  
Shanghai, P. R. China

### **Aske S. Donslund**

Department of Chemistry  
Aarhus University  
Aarhus C, Denmark

### **Dipak Kumar Dutta**

Materials Science and  
Technology Division  
CSIR-North-East Institute of  
Science and Technology (NEIST)  
Assam, India

### **Xianjie Fang**

School of Chemistry and  
Chemical Engineering  
Shanghai Jiao Tong University  
Shanghai, P. R. China

### **Bartolo Gabriele**

Department of Chemistry  
and Chemical Technologies  
Laboratory of Industrial and  
Synthetic Organic Chemistry  
(LISOC)

University of Calabria  
Arcavacata di Rende, Italy

### **Haraldur G. Gudmundsson**

Department of Chemistry  
Aarhus University  
Aarhus C, Denmark

### **Yong-Yuan Gui**

Key Laboratory of Green  
Chemistry & Technology  
of Ministry of Education  
College of Chemistry  
Sichuan University  
Chengdu, P. R. China

### **Buxing Han**

Beijing National Laboratory  
for Molecular Sciences  
CAS Key Laboratory of  
Colloid and Interface and  
Thermodynamics  
Institute of Chemistry  
Chinese Academy of Sciences  
Beijing, P. R. China

### **Liang-Nian He**

State Key Laboratory and  
Institute of Elemento-Organic  
Chemistry  
College of Chemistry  
Nankai University  
Tianjin, P. R. China

### **Yuan-Xu Jiang**

Key Laboratory of Green  
Chemistry & Technology  
of Ministry of Education  
College of Chemistry  
Sichuan University  
Chengdu, P. R. China

### **Yue-Ming Jiang**

Key Laboratory of Green  
Chemistry & Technology  
of Ministry of Education  
College of Chemistry  
Sichuan University  
Chengdu, P. R. China

### **Ke Jing**

Key Laboratory of Green  
Chemistry & Technology of  
Ministry of Education  
College of Chemistry  
Sichuan University  
Chengdu, P. R. China

### **Martin B. Johansen**

Department of Chemistry  
Aarhus University  
Aarhus C, Denmark

### **Arjan Kleij**

The Barcelona Institute of Science  
& Technology (BIST) Institute of  
Chemical Research of Catalonia  
(ICIQ)  
Tarragona, Spain

### **Aiwen Lei**

College of Chemistry  
and Molecular Sciences  
Institute for Advanced Studies  
(IAS)

Wuhan University  
Wuhan, P. R. China

### **Can Li**

Dalian Institute  
of Chemical Physics  
Chinese Academy of Sciences  
Dalian, P. R. China

### **Hong-Ru Li**

State Key Laboratory and  
Institute of Elemento-Organic  
Chemistry  
College of Chemistry  
Nankai University  
Tianjin, P. R. China

### **Wangfang Li**

Department of Chemistry  
College of Science  
University of Shanghai  
for Science and Technology  
Shanghai, P. R. China

### **Wen-Bing Li**

State Key Laboratory of Fine  
Chemicals  
Dalian University of Technology  
Dalian, P. R. China

### **Yuehui Li**

State Key Laboratory for Oxo  
Synthesis and Selective Oxidation  
Suzhou Research Institute  
Lanzhou Institute of Chemical  
Physics  
Chinese Academy of Sciences  
Lanzhou, P. R. China

### **Xinyi Liu**

State Key Laboratory of Catalysis  
Dalian Institute of Chemical  
Physics  
Chinese Academy of Sciences  
Dalian, P. R. China

### **Yunyun Liu**

College of Chemistry and  
Chemical Engineering  
Jiangxi Normal University  
Nanchang, P. R. China

### **Zhongmin Liu**

Dalian Institute of Chemical  
Physics  
Chinese Academy of Sciences  
Dalian, P. R. China

### **Xiao-bing Lu**

State Key Laboratory of Fine  
Chemicals  
Dalian University of Technology  
Dalian, P. R. China

### **Raffaella Mancuso**

Department of Chemistry  
and Chemical Technologies  
Laboratory of Industrial and  
Synthetic Organic Chemistry  
(LISOC)  
University of Calabria  
Arcavacata di Rende, Italy

### **Karoline T. Neumann**

Department of Chemistry  
Aarhus University  
Aarhus C, Denmark

### **Ya-Nan Niu**

Key Laboratory of Green  
Chemistry & Technology  
of Ministry of Education  
College of Chemistry  
Sichuan University  
Chengdu, P. R. China

### **Werner Oberhauser**

Istituto di Chimica dei Composti  
Organometallici (CNR-ICCOM)  
Consiglio Nazionale delle  
Ricerche  
Sesto Fiorentino, Italy

### **Nilam Patil**

Department of Chemistry  
Institute of Chemical Technology  
Mumbai, India

### **Feng-Ling Qing**

Shanghai Institute of Organic  
Chemistry  
Key Laboratory of Organofluorine  
Chemistry  
Chinese Academy of Sciences  
Shanghai, P. R. China

### **Fabio Ragaini**

Dipartimento di Chimica  
Università degli Studi di Milano  
Milano, Italy

### **Anne K. Ravn**

Department of Chemistry  
Aarhus University  
Aarhus C, Denmark

### **Magnus H. Rønne**

Department of Chemistry  
Aarhus University  
Aarhus C, Denmark

### **Ilhyong Ryu**

Department of Chemistry  
Osaka Prefecture University  
Osaka, Japan

### **Feng Sha**

School of Materials Science  
and Engineering and National  
Institute for Advanced Materials  
Nankai University  
Tianjin, P. R. China

State Key Laboratory of  
Catalysis | Dalian Institute of  
Chemical Physics  
Chinese Academy of Sciences  
Dalian, P. R. China

### **Wenjie Shen**

Dalian Institute of Chemical  
Physics  
Chinese Academy of Sciences  
Dalian, P. R. China

### **Renyi Shi**

School of Chemical Engineering  
and Technology  
Xi'an Jiaotong University  
Xi'an, P. R. China

### **Troels Skrydstrup**

Department of Chemistry  
Aarhus University  
Aarhus C, Denmark

### **Xiangen Song**

Dalian National Laboratory  
for Clean Energy  
Dalian Institute of Chemical  
Physics  
Chinese Academy of Sciences  
Dalian, P. R. China

### **Shan Tang**

State Key Laboratory of Catalysis  
Dalian Institute of Chemical  
Physics  
Chinese Academy of Sciences  
Dalian, P. R. China

### **Fujihara Tetsuaki**

Graduate School of Engineering  
Department of Energy and  
Hydrocarbon Chemistry  
Kyoto University  
Kyoto, Japan

### **Jieping Wan**

College of Chemistry and  
Chemical Engineering  
Jiangxi Normal University  
Nanchang, P. R. China

### **Jiji Wang**

State Key Laboratory of Catalysis  
Dalian Institute of Chemical  
Physics  
Chinese Academy of Sciences  
Dalian, P. R. China

### **Ye Wang**

State Key Laboratory of Physical  
Chemistry of Solid Surfaces  
College of Chemistry and  
Chemical Engineering  
Xiamen University  
Xiamen, P. R. China

### **Zechao Wang**

Division of Molecular Catalysis  
& Synthesis  
Henan Institute of Advanced  
Technology  
Zhengzhou University  
Zhengzhou, P. R. China

### **Yingxu Wei**

Dalian Institute of Chemical  
Physics  
Chinese Academy of Sciences  
Dalian, P. R. China

### **Xiao-Feng Wu**

Leibniz-Institut für Katalyse e.V.  
(LIKAT Rostock)  
Rostock, Germany

### **Chungu Xia**

State Key Laboratory for Oxo  
Synthesis and Selective Oxidation  
Suzhou Research Institute  
Lanzhou Institute of Chemical  
Physics  
Chinese Academy of Sciences  
Lanzhou, P. R. China

### **Xiu-Hua Xu**

Shanghai Institute  
of Organic Chemistry  
Key Laboratory of Organofluorine  
Chemistry  
Chinese Academy of Sciences  
Shanghai, P. R. China

### **Fachao Yan**

State Key Laboratory for Oxo  
Synthesis and Selective Oxidation  
Suzhou Research Institute  
Lanzhou Institute of Chemical  
Physics  
Chinese Academy of Sciences  
Lanzhou, P. R. China

### **Li Yan**

Dalian National Laboratory  
for Clean Energy  
Dalian Institute of Chemical  
Physics  
Chinese Academy of Science  
Dalian, P. R. China

### **Zhi-Wen Yang**

State Key Laboratory and  
Institute of Elemento-Organic  
Chemistry  
College of Chemistry  
Nankai University  
Tianjin, P. R. China

### **Xiang-Yang Yao**

State Key Laboratory and  
Institute of Elemento-Organic  
Chemistry  
College of Chemistry  
Nankai University  
Tianjin, P. R. China

### **Zhiping Yin**

School of Pharmacy  
Jiangsu University  
Zhenjiang, P. R. China

### **Da-gang Yu**

Key Laboratory of Green  
Chemistry & Technology  
of Ministry of Education  
College of Chemistry  
Sichuan University  
Chengdu, P. R. China

### **Rongrong Yu**

School of Chemistry and  
Chemical Engineering  
Shanghai Jiao Tong University  
Shanghai, P. R. China

### **Wenna Zhang**

Dalian Institute of Chemical  
Physics  
Chinese Academy of Sciences  
Dalian, P. R. China

### **Xumu Zhang**

Department of Chemistry  
Shenzhen Grubbs Institute  
Southern University of Science and  
Technology  
Shenzhen, P. R. China

### **Qiang Zhu**

State Key Laboratory  
of Respiratory Disease  
Guangzhou Institutes  
of Biomedicine and Health  
Chinese Academy of Sciences  
Guangzhou, P. R. China

### **Zhiwei Zuo**

School of Physical Science  
and Technology  
ShanghaiTech University  
Shanghai, P. R. China

Information is accurate as of December 2021