

# Naohiko Yoshikai

Professor

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## Education

- 2005 Ph.D. (Chemistry)  
*Department of Chemistry, The University of Tokyo (Advisor: Prof. Eiichi Nakamura)*
- 2002 M.Sc. (Chemistry)  
*Department of Chemistry, The University of Tokyo*
- 2000 B.Sc. (Chemistry)  
*Department of Chemistry, The University of Tokyo*

## Professional Experience

- 2021.4–Present **Professor**  
*Graduate School of Pharmaceutical Sciences, Tohoku University*
- 2016.9–2021.3 **Associate Professor (tenured)**  
*Division of Chemistry and Biological Chemistry, School of Physical and Mathematical Sciences, Nanyang Technological University*
- 2009.7–2016.8 **Assistant Professor**  
*Division of Chemistry and Biological Chemistry, School of Physical and Mathematical Sciences, Nanyang Technological University*
- 2009.7–2014.6 **Research Fellow**  
*Singapore National Research Foundation (NRF)*
- 2005.2–2009.6 **Assistant Professor**  
*Department of Chemistry, The University of Tokyo*
- 2002.4–2005.2 **JSPS Young Research Fellow**

## Research Interests

Development and mechanistic study of novel catalytic transformations and their synthetic applications.

## Awards

- 2022 Mukaiyama Award
- 2020 TCI–SNIC Industry Award in Synthetic Chemistry
- 2015 Asian Core Program Lectureship (from Thailand)
- 2014 Chemical Society of Japan Award for Young Chemists
- 2014 Asian Core Program Lectureship (from China and Korea)
- 2011 Asian Core Program Lectureship (from Japan)
- 2011 Thieme Chemistry Journal Award
- 2007 Inoue Research Award for Young Scientists

## Publications

### Journal Publications and Preprints

146. Chai, J.; Ding, W.; Wang, C.; Ito, S.; Wu, J.; Yoshikai, N. Ritter-Type Iodo(III)amidation of Unactivated Alkynes for the Stereoselective Synthesis of Multisubstituted Enamides. *Chem. Sci.* **2021**, *12*, 15128-15133 (Preprint: Chai, J.; Ding, W.; Ito, S.; Wu, J.; Yoshikai, N. *ChemRxiv* **2021**, DOI: 10.33774/chemrxiv-2021-c2ftp.).
145. Sekiguchi, Y.; Yoshikai, N. Zinc-Catalyzed  $\beta$ -Functionalization of Cyclopropanols via Enolized Homoenate. *J. Am. Chem. Soc.* **2021**, *143*, 18400-18405 (Preprint: Sekiguchi, Y.; Yoshikai, N. *ChemRxiv* **2021**, DOI: 10.33774/chemrxiv-2021-4jlsj).
144. Sekiguchi, Y.; Lee, Y. Y.; Yoshikai, N. Nickel-Catalyzed Ring-Opening Allylation of Cyclopropanols via Homoenate. *Org. Lett.* **2021**, *23*, 5993-5997.
143. Sekiguchi, Y.; Yoshikai, N. Enantioselective Conjugate Addition of Catalytically Generated Zinc Homoenate. *J. Am. Chem. Soc.* **2021**, *143*, 4775-4781 (Preprint: Sekiguchi, Y.; Yoshikai, N. *ChemRxiv* **2021**, DOI: 10.26434/chemrxiv.13607438.v1).
142. Wang, C.-S.; Sun, Q.; Garcia, F.; Wang, C.; Yoshikai, N. Robust Cobalt Catalyst for Nitrile/Alkyne [2+2+2] Cycloaddition: Synthesis of Polyarylpyridines and Their Mechanochemical Cyclodehydrogenation to Nitrogen-Containing Polyaromatics. *Angew. Chem. Int. Ed.* **2021**, published online (Preprint: Wang, C.-S.; Sun, Q.; Garcia, F.; Wang, C.; Yoshikai, N. *ChemRxiv* **2021**, DOI: 10.26434/chemrxiv.13465697.v1).
141. Laskar, R. A.; Ding, W.; Yoshikai, N. Iodo(III)-Meyer-Schuster Rearrangement of Propargylic Alcohols Promoted by Benziodoxole Triflate. *Org. Lett.* **2021**, *23*, 1113-1117.
140. Sekiguchi, Y.; Yoshikai, N. Metal-Catalyzed Transformations of Cyclopropanols via Homoenolates. *Bull. Chem. Soc. Jpn.* **2021**, *1*, 265-280.
139. Xu, W.; Wu, M.; Yoshikai, N. Iron-Catalyzed Remote C-H Alkylation of 8-Amidoquinolines with Cycloalkanes. *Synthesis* **2020**, published online.
138. Chai, J.; Ding, W.; Wu, J.; Yoshikai, N. Fluorobenziodoxole-BF<sub>3</sub> Reagent for Iodo(III)etherification of Alkynes in Ethereal Solvent. *Chem. Asian J.* **2020**, *15*, 2166-2169.
137. Ding, W.; Wang, C.; Tan, J. R.; Ho, C. C.; León, F.; García, F.; Yoshikai, N. Site-selective aromatic C-H  $\lambda^3$ -iodination with cyclic iodine(III) electrophile in solution and solid phases. *Chem. Sci.* **2020**, *11*, 7356-7361.
136. Yang, J.; Mori, Y.; Yamanaka, M.; Yoshikai, N. Cobalt-Catalyzed Intramolecular Hydroacylation Involving Cyclopropane Cleavage. *Chem. Eur. J.* **2020**, *26*, 8302-8307.
135. Ding, W.; Chai, J.; Wang, C.; Wu, J.; Yoshikai, N. Stereoselective Access to Highly Substituted Vinyl Ethers via *trans*-Difunctionalization of Alkynes with Alcohols and Iodine(III) Electrophile. *J. Am. Chem. Soc.* **2020**, *142*, 8619-8624 (Preprint: Ding, W.; Chai, J.; Wu, J.; Yoshikai, N. *ChemRxiv* **2020**, DOI: 10.26434/chemrxiv.11770092.v1.).
134. Wang, C.-S.; Di Monaco, S.; Thai, A. N.; Wang, C.; Yoshikai, N. Cobalt/Lewis Acid Catalysis for Hydrocarbofunctionalization of Alkynes via Cooperative C-H Activation. *ChemRxiv* **2020**, DOI: 10.26434/chemrxiv.11760519.v1.
133. Rahman, M. S.; Yoshikai, N. Synthesis of Triphenylene-Fused Phosphole Oxides via C-H Functionalizations. *Beilstein J. Org. Chem.* **2020**, *16*, 524-529.
132. Laskar, R. A.; Yoshikai, N. Cobalt-Catalyzed, N-H Imine-Directed Arene C-H Benzoylation with Benzyl Phosphates. *J. Org. Chem.* **2019**, *84*, 13172-13178.
131. Ding, W.; Ho, Y. K. T.; Okuda, Y.; Wijaya, C. K.; Tan, Z. H.; Yoshikai, N. Cobalt-Catalyzed Hydroacylative Dimerization of Allenes Leading to Skipped Dienes.

- Org. Lett.* **2019**, *21*, 6173-6178.
130. Sun, Q.; Yoshikai, N. Cobalt-Catalyzed Tandem Radical Cyclization/C–C Coupling Initiated by Directed C–H Activation. *Org. Lett.* **2019**, *21*, 5238-5242.
129. Rahman, M. S.; Yoshikai, N. Synthesis and Properties of Phospha[5]helicenes Bearing Inner-Rim Phosphorus Center. *Org. Lett.* **2019**, *21*, 5238-5242.
128. Yang, J.; Sekiguchi, Y.; Yoshikai, N. Cobalt-Catalyzed Enantioselective and Chemodivergent Addition of Cyclopropanols to Oxabicyclic Alkenes. *ACS Catal.* **2019**, *9*, 5638-5644.
127. Wu, J.; Deng, X.; Yoshikai, N. Stereocontrolled Synthesis of Halovinylbenziodoxoles via Hydro- and Iodochlorination of Ethynylbenziodoxoles. *Chem. Eur. J.* **2019**, *25*, 7839-7842.
126. Xu, W.; Yoshikai, N. Iron-Catalyzed *ortho* C–H Arylation and Methylation of Pivalophenone N–H Imines. *ChemSusChem* **2019**, *12*, 3049-3053.
125. Yan, J.; Rahman, M. S.; Yoshikai, N. Pd-Catalyzed Annulation of 1-Halo-8-arylnaphthalenes and Alkynes Leading to Heptagon-Embedded Aromatic Systems, *Chem. Eur. J.* **2019**, DOI: 10.1002/chem.201805746.
124. Yang, J.; Sun, Q.; Yoshikai, N. Cobalt-Catalyzed Regio- and Diastereoselective Formal [3+2] Cycloaddition between Cyclopropanols and Allenes. *ACS Catal.* **2019**, *9*, 1973-1978.
123. Ding, W.; Yoshikai, N. Cobalt-Catalyzed Intermolecular [2+2] Cycloaddition between Alkynes and Allenes. *Angew. Chem. Int. Ed.* **2019**, *58*, 2500-2504.
122. Ding, W.; Ho, C. C.; Yoshikai, N. Photosensitized, Energy-Transfer-Mediated Cyclization of 2-(1-Arylvinyl)benzaldehydes to Anthracen-9-(10*H*)-ones. *Org. Lett.* **2019**, *21*, 1202-1206.
121. Yoshikai, N. Recent Advances in Enantioselective C–C Bond Formation via Organocobalt Species. *Synthesis* **2019**, *51*, 135-145.
120. Yang, J.; Shen, Y.; Lim, Y. J.; Yoshikai, N. Divergent ring-opening coupling between cyclopropanols and alkynes under cobalt catalysis. *Chem. Sci.* **2018**, *9*, 6928-6934.
119. Sun, Q.; Yoshikai, N. Cobalt-catalyzed directed *ortho*-methylation of arenes with methyl tosylate. *Org. Chem. Front.* **2018**, *7*, 2214-2218.
118. Wu, C.; Yoshikai, N. Cobalt-Catalyzed Intramolecular Reactions between a Vinylcyclopropane and an Alkyne: Switchable [5+2] Cycloaddition and Homo-Ene Pathways. *Angew. Chem. Int. Ed.* **2018**, *57*, 6558-6562.
117. Xu, W.; Pek, J. H.; Yoshikai, N. Iron-Catalyzed Directed C–H Silylation of Pivalophenone N–H Imines. *Asian J. Org. Chem.* **2018**, *14*, 1351-1354.
116. Xu, W.; Yoshikai, N. Cobalt-Catalyzed Directed C–H Alkenylation of Pivalophenone N–H Imine with Alkenyl Phosphates. *Beilstein J. Org. Chem.* **2018**, *14*, 709-715.
115. Sun, Q.; Yoshikai, N. Cobalt-Catalyzed C(sp<sup>2</sup>)–H/C(sp<sup>3</sup>)–H Coupling via Directed C–H Activation and 1,5-Hydrogen Atom Transfer. *Org. Chem. Front.* **2018**, *5*, 582-585.
114. Tan, W. W.; Wu, B.; Wei, Y.; Yoshikai, N. Copper and Secondary Amine-Catalyzed Pyridine Synthesis from O-Acetyl Oximes and  $\alpha,\beta$ -Unsaturated Aldehydes. *Org. Synth.* **2018**, *95*, 1-14.
113. Xu, W.; Yoshikai, N. Cobalt-Catalyzed, N–H Imine-Directed Hydroarylation of Styrenes. *Org. Lett.* **2018**, *20*, 1392-1395.
112. Lee, P.-S.; Xu, W.; Yoshikai, N. Directed C–H Alkenylation of Aryl Imines with Alkenyl Phosphates Promoted by a Cobalt–N-Heterocyclic Carbene Catalyst. *Adv. Synth. Catal.* **2017**, *359*, 4340-4347 (Very Important Paper).
111. Yan, J.; Yoshikai, N. Phenanthrene Synthesis via Chromium-Catalyzed Annulation

- of 2-Biaryl Grignard Reagents and Alkynes. *Org. Lett.* **2017**, *19*, 6630-6633.
110. Wu, B.; Wu, J.; Yoshikai, N. Benziodoxole Triflate as a Versatile Reagent for Iodo(III)cyclization of Alkynes. *Chem. Asian J.* **2017**, *12*, 3123-3127.
109. Yoshikai, N. Iron-Catalyzed C–C Bond Formation via Chelation-Assisted C–H Activation. *Isr. J. Chem.* **2017**, *57*, 1117-1130.
108. Yan, J.; Yoshikai, N. Chromium-Catalyzed Migratory Arylmagnesiation of Unactivated Alkynes. *Org. Chem. Front.* **2017**, *4*, 1972-1975.
107. Xu, W.; Yoshikai, N. Pivalophenone Imine as a Benzonitrile Surrogate for Directed C–H Bond Functionalization. *Chem. Sci.* **2017**, *8*, 5299-5304.
106. Yoshikai, N.; Santra, M.; Wu, B. Synthesis of Donor-Acceptor-Type Benzo[*b*]phosphole and Naphtho[2,3-*b*]phosphole Oxides and Their Solvatochromic Properties. *Organometallics* **2017**, *20*, 1392-1395.
105. Tan, W. W.; Ong, Y. J.; Yoshikai, N. Synthesis of Highly Substituted Pyridines through Copper-Catalyzed Condensation of Oximes and  $\alpha,\beta$ -Unsaturated Imines. *Angew. Chem. Int. Ed.* **2017**, *56*, 8240-8244.
104. Wu, B.; Melvina; Wu, X.; Yeow, E. K. L.; Yoshikai, N. Versatile Telluracyclic Synthesis via the Sequential Electrophilic Telluration of C(sp<sup>2</sup>)–Zn and C(sp<sup>2</sup>)–H Bonds. *Chem. Sci.* **2017**, *8*, 4527-4532.
103. Yang, J.; Rérat, A.; Lim, Y. J.; Gosmini, C.; Yoshikai, N. Cobalt-Catalyzed Enantio- and Diastereoselective Hydroacylation of Trisubstituted Alkenes. *Angew. Chem. Int. Ed.* **2017**, *56*, 2449-2453.
102. Wu, J.; Xu, K.; Hirao, H.; Yoshikai, N. Pd-Catalyzed, Ligand-Enabled Stereoselective 1,2-Iodine(III) Shift/1,1-Carboxyalkynylation of Alkynylbenziodoxoles. *Chem. Eur. J.* **2017**, *23*, 1521-1525.
101. Xu, W.; Yoshikai, N. N–H Imine as a Powerful Directing Group for Cobalt-Catalyzed Olefin Hydroarylation. *Angew. Chem. Int. Ed.* **2016**, *55*, 12731-12735.
100. Xu, W.; Pek, J. H.; Yoshikai, N. Cobalt-Catalyzed, Imine-Directed Olefin Hydroarylation under Grignard-Free Conditions. *Adv. Synth. Catal.* **2016**, *358*, 2564-2568
99. Wu, J.; Deng, X.; Hirao, H.; Yoshikai, N. Pd-Catalyzed Conversion of Alkynyl- $\lambda^3$ -iodanes to Alkenyl- $\lambda^3$ -iodanes via Stereoselective 1,2-Iodine(III) Shift/1,1-Hydrocarboxylation. *J. Am. Chem. Soc.* **2016**, *138*, 9105-9108.
98. Tan, W. W.; Yoshikai, N. Copper-Catalyzed Coupling of 2-Siloxy-1-alkenes and Diazocarbonyl Compounds: Approach to Multisubstituted Furans, Pyrroles, and Thiophenes. *J. Org. Chem.* **2016**, *81*, 5566-5573.
97. Yan, J.; Yoshikai, N. Cobalt-Catalyzed Arylative Cyclization of Acetylenic Esters and Ketones with Arylzinc Reagents through 1,4-Cobalt Migration. *ACS Catal.* **2016**, *6*, 3738-3742.
96. Wu, B.; Yoshikai, N. Recent Developments in Synthetic Methods for Benzo[*b*]heteroles. *Org. Biomol. Chem.* **2016**, *14*, 5402-5416.
95. Yang, J.; Yoshikai, N. Cobalt-Catalyzed Annulation of Salicylaldehydes and Alkynes to Form Chromones and 4-Chromanones. *Angew. Chem. Int. Ed.* **2016**, *55*, 2870-2874.
94. Wu, J.; Yoshikai, N. Cobalt-Catalyzed Alkenylzincation of Unfunctionalized Alkynes. *Angew. Chem. Int. Ed.* **2016**, *55*, 336-340.
93. Wu, B.; Chopra, R.; Yoshikai, N. One-Pot Benzo[*b*]phosphole Synthesis through Sequential Alkyne Arylmagnesiation, Electrophilic Trapping, and Intramolecular Phospha-Friedel–Crafts Cyclization. *Org. Lett.* **2015**, *17*, 5666-5669.

92. Wu, J.; Yoshikai, N. Modular Synthesis of Multisubstituted Furans through Palladium-Catalyzed Three-Component Condensation of Alkynylbenziodoxoles, Carboxylic Acids, and Imines. *Angew. Chem. Int. Ed.* **2015**, *54*, 11107-11111.
91. Xu, W.; Paira, R.; Yoshikai, N. Ortho-C–H Benzylolation of Aryl Imines with Benzyl Phosphates under Cobalt–Pyphos Catalysis. *Org. Lett.* **2015**, *17*, 4192-4195.
90. Tan, W. W.; Yoshikai, N. Copper-Catalyzed Condensation of Imines and  $\alpha$ -Diazo- $\beta$ -dicarbonyl Compounds: Modular and Regiocontrolled Synthesis of Multisubstituted Pyrroles. *Chem. Sci.* **2015**, *6*, 6448-6455.
89. Wu, B.; Yoshikai, N. Conversion of 2-Iodobiaryls into 2,2-Diiodobiaryls via Oxidation-Iodination Sequences: A Versatile Route to Ladder-Type Heterofluorenes. *Angew. Chem. Int. Ed.* **2015**, *54*, 8736-8739.
88. Yang, J.; Seto, Y. W.; Yoshikai, N. Cobalt-Catalyzed Intermolecular Hydroacylation of Olefins through Chelation-Assisted Imido C–H Activation. *ACS Catal.* **2015**, *5*, 3054-3057.
87. Yoshikai, N. Cp\*Co<sup>III</sup>-Catalyzed C–H Activation of (Hetero)arenes: Expanding the Scope of Base-Metal-Catalyzed C–H Functionalization. *ChemCatChem* **2015**, *7*, 732-734. (one of most accessed articles in Feb 2015)
86. Wong, M. Y.; Yamakawa, T.; Yoshikai, N. Iron-Catalyzed Directed C2-Alkylation and Alkenylation of Indole with Vinylarenes and Alkynes. *Org. Lett.* **2015**, *17*, 442-445.
85. Lee, P.-S.; Yoshikai, N. Cobalt-Catalyzed Enantioselective Directed C–H Alkylation of Indoles with Styrenes. *Org. Lett.* **2015**, *17*, 22-25.
84. Yamakawa, T.; Seto, Y. W.; Yoshikai, N. Cobalt-Catalyzed Directed Alkylation of Olefinic C–H Bond with Primary and Secondary Alkyl Chlorides. *Synlett* **2015**, *26*, 340-344.
83. Xu, W.; Yoshikai, N. Highly Linear-Selective Cobalt-Catalyzed Addition of Aryl Imines to Styrenes: Reversing Intrinsic Regioselectivity by Ligand Elaboration. *Angew. Chem. Int. Ed.* **2014**, *53*, 14166-14170.
82. Yang, J.; Yoshikai, N. Cobalt-Catalyzed Enantioselective Intramolecular Hydroacylation of Ketones and Olefins. *J. Am. Chem. Soc.* **2014**, *136*, 16748-16751. [one of most accessed articles in Nov 2014]
81. Yoshikai, N. Cobalt-Catalyzed C–C Bond-Forming Reactions via Chelation-Assisted C–H Activation. *J. Synth. Org. Chem. Jpn.* **2014**, *72*, 1198-1206.
80. Tan, W. W.; Hou, X.; Yoshikai, N. Pd(II)/Bu<sub>4</sub>NBr/DMSO Catalytic System for Practical Synthesis of Indoles and Pyrroles from Imines through Aerobic Dehydrogenative Cyclization. *Synthesis* **2014**, *46*, 2727-2733.
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74. Tan, B.-H.; Yoshikai, N. Cobalt-Catalyzed Addition of Arylzinc Reagents to Norbornene Derivatives through 1,4-Cobalt Migration. *Org. Lett.* **2014**, *16*, 3392-3395.
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58. Wei, Y.; Yoshikai, N. Modular Pyridine Synthesis from Oximes and Enals through Synergistic Copper/Iminium Catalysis. *J. Am. Chem. Soc.* **2013**, *135*, 3756-3759.
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- Cobalt-Catalyzed Olefinic C–H Activation. *Org. Lett.* **2013**, *15*, 196-199.
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