

Reductive *anti*-Dizincation of Arylacetylenes

Haruka Yamaguchi,^[a] Fumiya Takahashi,^[a] Takashi Kurogi,^[a] and Hideki Yorimitsu^{*[a]}

[a] H. Yamaguchi, Dr. F. Takahashi, Dr. T. Kurogi, Prof. Dr. H. Yorimitsu

Department of Chemistry

Graduate School of Science, Kyoto University

Sakyo-ku, 606-8502 Kyoto (Japan)

E-mail: yori@kuchem.kyoto-u.ac.jp

Abstract: Arylacetylenes undergo *anti*-1,2-dizincation to afford *trans*-1,2-dizincioalkenes. The process employs sodium dispersion as a reducing agent and zinc chloride TMEDA complex as a reduction-resistant zinc electrophile. This reductive *anti*-dizincation contrasts with the conventional additive *syn*-dimetalation like silylzincation. The resulting dizincated alkenes undergo the cross-coupling to yield multi-substituted alkenes stereoselectively.

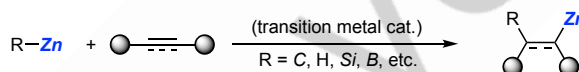
Introduction

Organozinc reagents play an important role in organic synthesis, exemplified by the widespread application of the Negishi coupling reaction.^[1] Preparation of organozinc reagents has thus been widely investigated. The preparation typically involves either metalation of organic halides via a reductive process or halogen-metal exchange, or deprotonation of acidic C-H bonds.^[1,2] Besides these practical methods, addition of an organozinc reagent or a related zinc species onto an unsaturated C-C bond offers distinct advantages, enabling the synthesis of organozinc reagents with increased molecular complexity and synthetic utility (Figure 1A). Carbozincation and hydrozincation represent notable examples.^[1,3] Furthermore, metallozincation reactions, including silylzincation, provide ways for utilizing both the organozinc unit and the other organometallic unit for subsequent functionalizations.^[4] Notably, these “additive” zincation reactions typically proceed in a *syn* fashion, with exceptions observed in special substrates.^[4g,h,j] This inherent *syn*-selectivity has rendered the additive zincation reactions^[5] particularly valuable for the stereocontrolled synthesis of multisubstituted alkenes. Conversely, *anti*-addition of a zinc species across an unsaturated C-C bond has only been sporadically reported.^[4g,h,j,6]

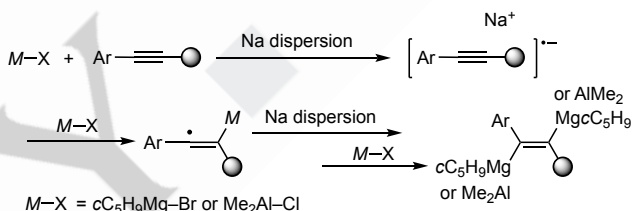
Recently we reported the dimagnesiation and dialumination of alkynes (Figure 1B).^[7] These dimetalation reactions proceed intriguingly in an *anti* fashion, employing a distinct mechanistic pathway involving electron injection from sodium dispersion^[8] into the alkyne followed by the trapping of the resulting anionic species with cyclopentylmagnesium bromide and dimethylaluminum chloride that are resistant to reduction.^[9] Notably, magnesium dichloride and aluminum trichloride were ineffective due to their rapid reduction into the corresponding Rieke metals^[10] under the reduction conditions, which precludes the electron injection into

the alkyne. The unconventional *anti*-dimetalation process yields (*E*)-*vic*-dimetalloalkene, which has indeed shown promising applications in organic synthesis.

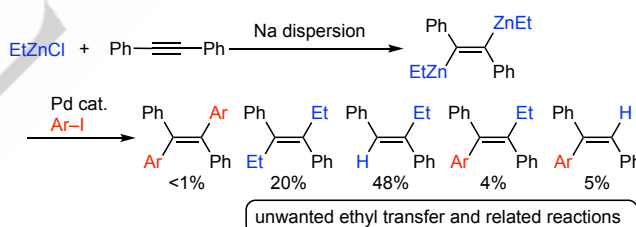
A. Additive *syn*-addition of a zinc reagent onto a C-C multiple bond



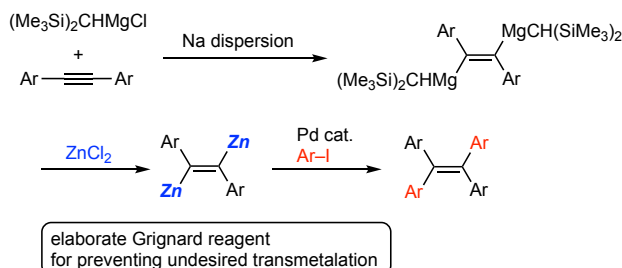
B. Reductive *anti*-dimetalation of alkynes



C. Initially attempted reductive *anti*-dizincation followed by Negishi coupling



D. Reductive *anti*-dimagnesiation followed by transmetalation with $ZnCl_2$



E. Straightforward reductive *anti*-dizincation with $ZnCl_2(tmeda)$ [This Work]

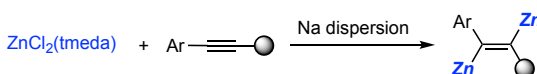


Figure 1. Metalation of C-C multiple bonds.

Considering the importance of organozinc reagents, we naturally envisioned developing a method for the reductive generation of *anti*-dizincated alkenes. Our preliminary attempt by using ethylzinc chloride was indeed successful to achieve the reductive *anti*-dizincation (Figure 1C). However, the subsequent Negishi coupling reaction failed to efficiently yield diarylated products, rather providing a complicated mixture containing several types of ethylated and reduced byproducts, which might be derived from the ethyl transfer from the zinc center (and subsequent β -hydride elimination).^[11] To avoid the unwanted ethyl transfer, we were compelled to use transmetalation between dimagnesiased species and zinc chloride (Figure 1D).^[12] This dimagnesiation/transmetalation approach required the use of bis(trimethylsilyl)methylmagnesium chloride as an elaborate magnesium-based trapping agent, which is crucial for preventing undesired transmetalation of the alkyl group on the magnesium center and ensuring selective transfer of the vinylene unit to palladium.

However, the limited accessibility of the Grignard reagent as well as its precursor, which requires prior preparation, underscores the need for a more convenient protocol for *anti*-dizincation reactions. Ideally, a protocol for reductive *anti*-dizincation of alkynes should directly utilize a simple zinc salt without complicated ligands like the dummy bis(trimethylsilyl)methyl ligand. Intuitively, the use of simple zinc halides had been expected to be unsuccessful due to the facile formation of Rieke zinc.^[10] Here we report that the intuition is incorrect and that simple $\text{ZnCl}_2(\text{tmeda})$ ($\text{tmeda} = N,N,N',N'$ -tetramethylethylenediamine) serves as a reduction-resistant electrophile to achieve the straightforward reductive *anti*-dizincation of alkynes (Figure 1E). The present dizincation method is significantly more efficient than the previous dizincation via dimagnesiation.

Results and Discussion

Table 1 illustrates the optimization of reaction conditions for the model dizincation of tolane (**1a**) followed by protonation to yield stilbene (**2a**), focusing on zinc electrophiles. Following our previous dimagnesiation,^[12] investigations began at 0 °C using simple zinc chloride. The reaction afforded **2a** in 38% yield with high *E* selectivity, the remainder being mostly the recovery of **1a** (entry 1). This result is promising, suggesting that a zinc salt can be used for *anti*-dizincation. On the other hand, a part of zinc chloride seemed to undergo reduction to form Rieke zinc, which is ineffective in reducing **1a**, as the color of the reaction mixture turned black upon the addition of sodium dispersion. To avoid the formation of Rieke zinc, the reaction was then performed at –20 °C, resulting in a significant improvement in both yield and selectivity, albeit with the recovery of **1a** (entry 2). To address the consumption of ZnCl_2 , 3 equivalents of ZnCl_2 and sodium dispersion were employed (entry 3). However, the yield and selectivity were not satisfactory.

Subsequently, other zinc electrophiles were investigated. Zinc bromide exhibited reactivity similar to zinc chloride yet failed

to suppress the formation of Rieke zinc (entry 4). Zinc iodide underwent more facile reduction (entry 5). Assuming that coordination of amine ligands would make the zinc center more electron-rich to suppress the reduction, the TMEDA complexes of these three zinc halides were examined (entries 6–8). While all of them showed similar behavior, $\text{ZnCl}_2(\text{tmeda})$ encouragingly demonstrated the best performance in terms of achieving a balance between yield and stereoselectivity. Deuteration with $\text{DCI}/\text{D}_2\text{O}$, instead of protonation with aqueous HCl, naturally gave dideuterated stilbene (**2a-d₂**) in 91% yield with 98% deuterium incorporation and an *E:Z* ratio of 93:7. This outcome strongly suggests the intermediacy of *anti*-dizincated species.

Tetramethylpropylenediamine (entry 9), featuring an additional methylene unit between the two nitrogens, did not effectively suppress the formation of Rieke zinc. The additional methylene unit would allow the complex to be looser and one of the nitrogen atoms to dissociate more easily from the zinc center. Other firmly coordinating ethylenediamines such as tetraethylethylenediamine (entry 10) and bis(tetramethylene)ethylenediamine (entry 11) completely inhibited the reduction of the zinc complexes, albeit with moderate stereoselectivity. We suppose these bulkier diamines would influence the structure of the vicinal sodiozincalkene that is the immediate precursor of the dizincated intermediate: the bulkier diamine unit would push the vicinal phenyl group more to the opposite side of the double bond and be inclined to accommodate the smaller sodium atom on the same side, which could lead to the slightly increased formation of the *Z* isomer. A zinc alkoxide bearing an intramolecularly coordinating dimethylamino group^[13] showed lower stereoselectivity (entry 12).

Table 1. Optimization of the reaction conditions.

$\text{Ph}-\text{C}\equiv\text{C}-\text{Ph} \xrightarrow[\text{THF (0.2 M), -20 }^\circ\text{C, 0.5 h}]{\substack{2.0 \text{ equiv Zn electrophile} \\ 2.0 \text{ equiv Na dispersion}}} \text{Ph}-\text{C}(\text{Zn})=\text{C}(\text{Zn})-\text{Ph} \xrightarrow{\text{HCl aq.}} \text{Ph}-\text{CH}=\text{CH}-\text{Ph}$			
Entry	Zn electrophile	yield (%) ^[a]	<i>E:Z</i> ^[a]
1	ZnCl_2 , at 0 °C	38	90:10
2	ZnCl_2	62	99:1
3	3.0 equiv ZnCl_2 ^[b]	77	90:10
4	ZnBr_2	64	94:6
5	ZnI_2	33	78:22
6	$\text{ZnCl}_2(\text{tmeda})$ ^[c]	94	93:7
7	$\text{ZnBr}_2(\text{tmeda})$ ^[c]	80	94:6
8	$\text{ZnI}_2(\text{tmeda})$ ^[c]	79	90:10
9	$\text{ZnCl}_2(\text{tmpda})$ ^[d]	47	85:15
10	$\text{ZnCl}_2(\text{teeda})$ ^[e]	99	83:17
11	$\text{ZnCl}_2(\text{btmeda})$ ^[f]	99	86:14
12	$\text{ZnCl}(\text{OCH}_2\text{CH}_2\text{NMe}_2)$	87	70:30

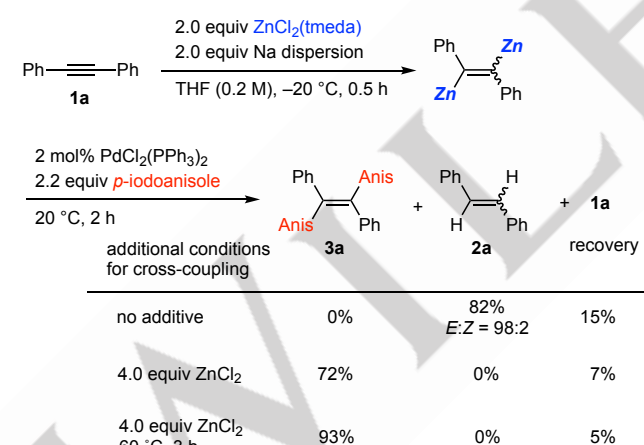
[a] Yields and *E/Z* ratios were determined by ^1H NMR using dibromomethane as an internal standard. The remainder is the recovery of **1a**. [b] 3.0 equiv of both ZnCl_2 and Na dispersion. [c] $\text{tmeda} = \text{Me}_2\text{NCH}_2\text{CH}_2\text{NMe}_2$. [d] $\text{tmpda} = \text{Me}_2\text{NCH}_2\text{CH}_2\text{CH}_2\text{NMe}_2$. [e] $\text{teeda} = \text{Et}_2\text{NCH}_2\text{CH}_2\text{NEt}_2$. [f] $\text{btmeda} = (\text{CH}_2)_4\text{NCH}_2\text{CH}_2\text{N}(\text{CH}_2)_4$.

With the optimized conditions for *anti*-dizincation in hand (entry 6), the two-fold Negishi coupling with *p*-iodoanisole was explored for the stereocontrolled synthesis of multi-substituted alkenes of synthetic importance.^[14] Unexpectedly, the cross-

coupling reaction did not occur at all (Scheme 1). Instead, **2a** was obtained after aqueous work-up. During the dizincation, formation of ochre-colored precipitate was always observed. While the precipitate was initially presumed to be sodium chloride, we began to suspect that this precipitate could contain insoluble polymeric dizincated intermediates, rendering them unable to participate in the cross-coupling. To address this issue, additives were screened to deaggregate the insoluble intermediates.^[15] To our satisfaction, an addition of zinc chloride (4 equiv) to the reaction mixture was found to facilitate the conversion of the dizincated species into the desired cross-coupling product **3a** in 72% yield. Performing the cross-coupling reaction at a higher temperature of 60 °C enhanced the yield of **3a** up to 93%. Notably, the use of lithium chloride, known to play a special role in promoting the Negishi coupling,^[16] instead of zinc chloride, did not have any influences on the efficiency of the coupling (67% yield of stilbene).

Notably, after the cross-coupling in Scheme 1, **3a** was obtained with exclusive *E* selectivity and the recovery of **1a** was observed. These phenomena imply that the minor *syn*-dizincated intermediate did not undergo cross-coupling but served as a reductant during the cross-coupling process to be converted to the starting material **1a**. The *syn*-dizincated intermediate would be reactive to reduce divalent palladium intermediates such as anisylpalladium iodide. The conversions of *vic*-dimetallated alkenes back to the starting alkynes were also observed in the previous dimetalation reactions.^[7,12]

Scheme 1. Optimization of subsequent two-fold Negishi coupling.



Anis = *p*-MeOC₆H₄.

Scheme 2 illustrates the scope of the sequential dizincation/cross-coupling.^[17] With **1a** as the substrate, a variety of iodoarenes participated in the cross-coupling to afford **3a–d** in high yields.^[18] Ethyl bromobenzoate reacted instead of its iodo analog to yield **3b** in 69% yield. On the other hand, the choice of alkynes is important: Alkynes should be reduced more rapidly than the zinc electrophile (See Supporting Information for CV data for alkynes and ZnCl₂(tmeda)). Di-*p*-tolylacetylene was converted to **3e** in good yield, while di-*p*-methoxyphenylacetylene remained intact due to its more electron-rich nature (not shown). Alkynes

having a π -extended naphthyl group reacted to yield **3f** and **3g**. Electron-withdrawing boryl and cyano groups facilitated the electron injection into the alkyne to furnish **3h** and **3i** in moderate yields.^[19] Interestingly, the butyl-substituted alkyne having a cyano group participated to afford **3j** in 30% NMR yield even though an alkyl group is electron-donating. A pyridyl group is not an electron-accepting substituent to yield **3k** in only 20% NMR yield. Mono-methoxy- and mono-trimethylsilyl-substituted tolanes are satisfactorily reactive substrates to afford **3l** and **3m** in 58% and 66% NMR yields, respectively. The yields could be enhanced to 76% and 79% NMR yields, respectively, when larger amounts of ZnCl₂(tmeda) and Na dispersion were used to facilitate smoother electron injection into these alkynes. *meta*-Monomethylsulfanyl-substituted tolane reacted smoothly under the standard conditions to yield **3n**. However, *ortho*-substituents inhibited the zincation probably due to their steric hindrance, which led to the formations of complicated mixtures. Not only aryl iodides but allyl bromide and benzyl bromide served as electrophiles for the cross-coupling to yield **4** and **5** efficiently. The reductive dizincation was also applicable to an alkynoate ester. In the reaction of *t*-butyl hept-2-ynoate as an electron-acceptor to yield **3o**, zinc chloride without TMEDA ligand was proved to be the better zinc electrophile and the stereoselectivity was marginal.

Conclusion

A new approach has been developed to achieve *anti*-dimetalation of alkynes. Arylacetylenes undergo *anti*-1,2-dizincation to afford *trans*-1,2-dizincioalkenes with high stereoselectivity. The process is straightforward and utilizes sodium dispersion as a reducing agent and zinc chloride TMEDA complex as a reduction-resistant zinc electrophile. The transformation begins with electron injection into the alkynes followed by trapping with the zinc electrophile. This reductive *anti*-dizincation represents a rare instance among dimetalation reactions, contrasting with the conventional additive *syn*-dimetalation reactions like silylzincation. The resulting dizincated alkenes undergo the Negishi cross-coupling, with the aid of additional zinc chloride to enhance the reactivity of the dizincated species. This reductive *anti*-dizincation and following Negishi coupling provide a new entry to *anti*-selective diarylation of alkynes.^[20] Ongoing efforts in our laboratory are focused on further developing new dimetalation reactions through reductive pathways.

Supporting Information

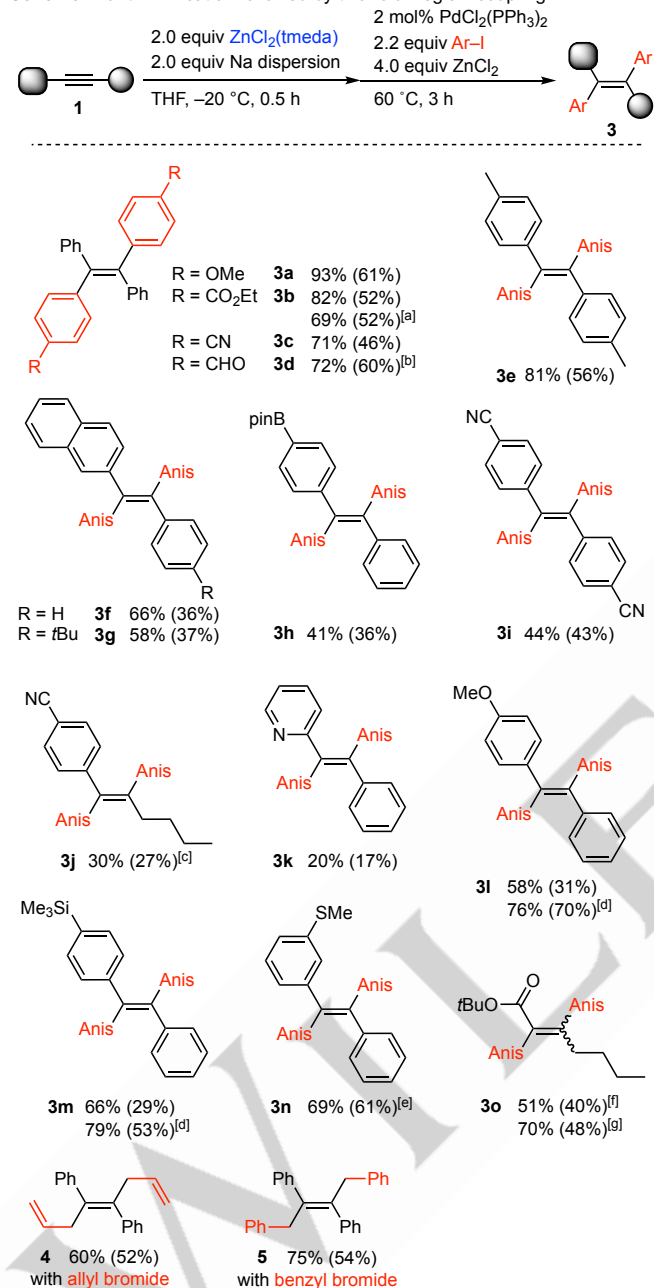
The Supporting Information contains all experimental procedures, characterization data, cyclic voltammograms, and copies of NMR spectra.

Acknowledgements

This work was supported by JST CREST Grant Number JPMJCR19R4 as well as JSPS KAKENHI Grant Number

JP19H00895 and JP24H02208 to H.Y. We thank KOBELCO ECO-Solutions CO., Ltd. for providing sodium dispersion.

Scheme 2. *anti*-Dizincation followed by two-fold Negishi coupling.



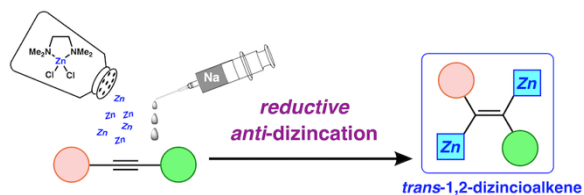
Anis = *p*-MeOC₆H₄. NMR yields are shown because isolation processes were often troublesome due to contamination with monoarylated trisubstituted alkenes (typically 5–10%) as inseparable by-products. Isolated yields are in parentheses. [a] Ethyl bromobenzoate was used instead of its iodo analog. [b] *E:Z* = 85:15. [c] *E:Z* = 95:5. [d] 3.0 equiv $\text{ZnCl}_2(\text{tmeda})$ and 2.2 equiv Na dispersion. [e] *E:Z* = 8:92. [f] *E:Z* = 4:96. [g] 2.0 equiv ZnCl_2 without TMEDA for the first step and without additional ZnCl_2 for the second step. *E:Z* = 22:78 before isolation.

Keywords: 1,2-Dizincioalkene • Dizincation • Reduction • Zinc • Sodium

- [1] a) E. Negishi, *Angew. Chem. Int. Ed.* **2011**, 50, 6738. b) D. Haas, J. M. Hammann, R. Greiner, P. Knochel, *ACS Catal.* **2016**, 6, 1540. c) B. Wei, P. Knochel, *Synthesis* **2022**, 54, 246.
- [2] a) P. Knochel, J. J. Almerna Perea, P. Jones, *Tetrahedron* **1998**, 54, 8275. b) P. Knochel, N. Millot, A. L. Rodriguez, C. E. Tucker, In *Organic Reactions*; John Wiley & Sons, Inc.: Hoboken, NJ, USA, **2001**, pp 417. c) P. Knochel, H. Leuser, L.-Z. Cong, S. Perrone, F. F. Kneisel, In *Handbook of Functionalized Organometallics*; Wiley-VCH: Weinheim, **2008**, pp 251. d) A. D. Dilman, V. V. Levin, *Tetrahedron Lett.* **2016**, 57, 3986. e) D. K. Wanic, R. Melvin, G. Barker, *Synthesis* **2023**, 55, 3487.
- [3] a) E. Lorthiois, C. Meyer, In *Patai's Chemistry of Functional Groups*; John Wiley & Sons, Ltd.: New York, **2009**. b) K. Murakami, H. Yorimitsu, *Beilstein J. Org. Chem.* **2013**, 9, 278. c) G. Sklute, H. Cavender, In *Organic React.*; John Wiley & Sons, Inc.: New York, **2015**; Vol. 87, Chapter 3.
- [4] a) K. Wakamatsu, T. Nonaka, Y. Okuda, W. Tückmantel, K. Oshima, K. Utimoto, H. Nozaki, *Tetrahedron* **1986**, 42, 4427. b) S. Nakamura, M. Uchiyama, T. Ohwada, *J. Am. Chem. Soc.* **2004**, 126, 11146. c) G. Auer, M. Oestreich, *Chem. Commun.* **2006**, 311. d) S. Nakamura, M. Yonehara, M. Uchiyama, *Chem. Eur. J.* **2008**, 14, 1068. e) Y. Nagashima, R. Takita, K. Yoshida, K. Hirano, M. Uchiyama, *J. Am. Chem. Soc.* **2013**, 135, 18730. f) M. Uchiyama, C. Wang, *Top. Organomet. Chem.* **2014**, 47, 159. g) E. Romain, C. Fopp, F. Chemla, F. Ferreira, O. Jackowski, M. Oestreich, A. Perez-Luna, *Angew. Chem. Int. Ed.* **2014**, 53, 11333. h) C. Fopp, E. Romain, K. Isaac, F. Chemla, F. Ferreira, O. Jackowski, M. Oestreich, A. Perez-Luna, *Org. Lett.* **2016**, 18, 2054. i) Y. Nagashima, D. Yukimori, C. Wang, M. Uchiyama, *Angew. Chem. Int. Ed.* **2018**, 57, 8053. j) K. de la Vega-Hernández, K. Isaac, F. Chemla, F. Ferreira, O. Jackowski, A. Perez-Luna, *Helv. Chim. Acta* **2021**, 104, e2100128.
- [5] Reductive carbozincation with zinc powder proceed also in a *syn* fashion: a) K. Nogi, T. Fujihara, J. Terao, Y. Tsuji, *J. Am. Chem. Soc.* **2016**, 138, 5547. b) H. D. Bishop, Q. Zhao, C. Uyeda, *J. Am. Chem. Soc.* **2023**, 145, 20152.
- [6] a) J. Maury, L. Feray, M. P. Bertrand, *Org. Lett.* **2011**, 13, 1884. b) C. W. Cheung, X. Hu, *Chem. Eur. J.* **2015**, 21, 18439. c) Y. Nishimoto, K. Kang, M. Yasuda, *Org. Lett.* **2017**, 19, 3927.
- [7] F. Takahashi, T. Kurogi, H. Yorimitsu, *Nat. Synth.* **2023**, 2, 162.
- [8] a) P. B. De, S. Asako, L. Ilies, *Synthesis* **2021**, 53, 3180. b) D. E. Anderson, A. Tortajada, E. Hevia, *Angew. Chem. Int. Ed.* **2024**, 63, e202313556.
- [9] a) F. Takahashi, K. Nogi, T. Sasamori, H. Yorimitsu, *Org. Lett.* **2019**, 21, 4739. b) M. Fukazawa, F. Takahashi, K. Nogi, T. Sasamori, H. Yorimitsu, *Org. Lett.* **2020**, 22, 2303. c) S. Ito, M. Fukazawa, F. Takahashi, K. Nogi, H. Yorimitsu, *Bull. Chem. Soc. Jpn.* **2020**, 93, 1171. d) S. Wang, A. Kaga, H. Yorimitsu, *Synlett* **2021**, 32, 219. e) S. Wang, A. Kaga, H. Yorimitsu, *Heterocycles* **2021**, 103, 1057. f) M. Fukazawa, F. Takahashi, H. Yorimitsu, *Org. Lett.* **2021**, 23, 4613. g) K. Miwa, S. Aoyagi, T. Sasamori, S. Morisako, H. Ueno, Y. Matsuo, H. Yorimitsu, *Molecules* **2022**, 27, 450. h) S. Wang, A. Kaga, T. Kurogi, H. Yorimitsu, *Org. Lett.* **2022**, 24, 1105. i) S. Koyama, F. Takahashi, H. Saito, H. Yorimitsu, *Synthesis* **2022**, 55, 1744. j) K. Miwa, S. Aoyagi, T. Amaya, T. Sasamori, S. Morisako, T. Kurogi, H. Yorimitsu, *Chem. Eur. J.* **2023**, 29, e202301557. k) Y. Jiang,

- T. Kurogi, H. Yorimitsu, *Nat. Synth.* **2024**, 3, 192. l) M. Fukazawa, F. Takahashi, T. Kurogi, H. Yorimitsu, *Chem. Asian J.* **2024**, 19, e2024100.
- [10] a) R. D. Rieke, *Science* **1989**, 246, 1260. b) R. D. Rieke, M. V. Hanson, *Tetrahedron* **1997**, 53, 1925.
- [11] G. Cahiez, L. Foulgoc, A. Moyeux, *Angew. Chem. Int. Ed.* **2009**, 48, 2969.
- [12] F. Takahashi, H. Yorimitsu, *Chem. Eur. J.* **2023**, 29, e202203988.
- [13] J. Hunger, S. Blaurock, J. Sieler, *Z. Anorg. Allg. Chem.*, **2005**, 631, 472.
- [14] a) K. Itami, J. Yoshida, *Bull. Chem. Soc. Jpn.* **2006**, 79, 811. b) A. B. Flynn, W. Ogilvie, *Chem. Rev.* **2007**, 107, 4698. c) M. Iwasaki, Y. Nishihara, *Chem. Rec.* **2016**, 16, 2031. d) W. Liu, W. Kong, *Org. Chem. Front.* **2020**, 7, 3941. e) J. Corpas, P. Mauleón, R. G. Arrayás, J. C. Carretero, *ACS Catal.* **2021**, 11, 7513. f) T. Tobrman, S. Mrkobrada, *Organics* **2022**, 3, 210.
- [15] a) P. Eckert, S. Sharif, M. G. Organ, *Angew. Chem. Int. Ed.* **2021**, 60, 12224. b) E. M. Hanada, T. K. S. Tagawa, M. Kawada, S. A. Blum, *J. Am. Chem. Soc.* **2022**, 144, 12081.
- [16] a) A. Krasovskiy, V. Malakhov, A. Gavryushin, P. Knochel, *Angew. Chem. Int. Ed.* **2006**, 45, 6040. b) K. Koszinowski, P. Böhrer, *Organometallics* **2009**, 28, 771. c) G. T. Achonduh, N. Hadei, C. Valente, S. Avola, C. J. O'Brien, M. G. Organ, *Chem. Commun.* **2010**, 46, 4109. d) I. S. MacIntosh, C. N. Sherren, K. N. Robertson, J. D. Masuda, C. C. Pye, J. A. C. Clyburne, *Organometallics* **2010**, 29, 2063. e) E. Hevia, R. E. Mulvey, *Angew. Chem. Int. Ed.* **2011**, 50, 6448. f) J. E. Fleckenstein, K. Koszinowski, *Organometallics* **2011**, 30, 5018. g) L. C. McCann, H. N. Hunter, J. A. C. Clyburne, M. G. Organ *Angew. Chem. Int. Ed.* **2012**, 51, 7024. h) L. C. McCann, M. G. Organ, *Angew. Chem. Int. Ed.* **2014**, 53, 438. i) S. Otsuka, D. Fujino, K. Murakami, H. Yorimitsu, A. Osuka, *Chem. Eur. J.* **2014**, 20, 13146. (h) K. Jess, K. Kitagawa, T. K. S. Tagawa, S. A. Blum, *J. Am. Chem. Soc.* **2019**, 141, 9879.
- [17] Attempts to trap the dizincated intermediates with electrophiles other than haloarenes resulted in failure. Treatment with iodine afforded the starting alkyne almost quantitatively through oxidation. PhSO_2SPh , acetyl chloride, and benzaldehyde did not react with the intermediate, stilbene being obtained after aqueous workup.
- [18] Attempts to trap the dizincated intermediate with two different electrophiles resulted in failure. Treatment with one equivalent of iodoanisole followed by protonation provided a mixture of desired monoarylated product (46% with 4:1 stereoselectivity), undesired diarylated product **3a** (22%), and undesired non-arylated stilbene (21%).
- [19] When the yields of the products are low to moderate, the remainders were often complicated mixtures.
- [20] a) W. Lv, S. Liu, Y. Chen, S. Wen, Y. Lan, G. Cheng, *ACS Catal.* **2020**, 10, 10516. b) P. Kumar, B. Maji, *J. Mater. Chem. A* **2023**, 11, 20752.

Entry for the Table of Contents



Arylacetylenes undergo *anti*-1,2-dizincation to afford *trans*-1,2-dizincioalkenes. The process employs sodium dispersion as a reducing agent and zinc chloride TMEDA complex as a reduction-resistant zinc electrophile. This reductive *anti*-dizincation contrasts with the conventional additive *syn*-dimetalation like silylzincation. The resulting dizincated alkenes undergo the cross-coupling to yield multi-substituted alkenes stereoselectively.