ORGANIC
LETTERS

2010
Vol. 12, No. 9
2000–2003

# Cu-Catalyzed Oxidative Amidation of Propiolic Acids Under Air via Decarboxylative Coupling

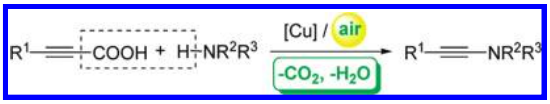
**Wei Jia**[†] **and Ning Jiao***[,†,‡]

*State Key Laboratory of Natural and Biomimetic Drugs, School of Pharmaceutical Sciences, Peking University, Xue Yuan Rd. 38, Beijing 100083, China, and Shanghai Key Laboratory of Green Chemistry and Chemical Processes, Department of Chemistry, East China Normal University, Shanghai 200062, China*

*jiaoning@bjmu.edu.cn*

**Received February 24, 2010**

## ABSTRACT



**A Cu-catalyzed aerobic oxidative amidation of propiolic acids via decarboxylation under air has been developed. Only carbon dioxide is produced as byproduct in this approach. The use of air as oxidant makes this method more useful and easy to handle.**

Transition metal-catalyzed C−N bond formation presents one of the most useful processes in syntheses of natural products, pharmaceuticals, and materials.[1] In particular, efficient and novel catalysis for the C(sp)−N bond has attracted much attention in the synthesis of ynamides due to their great importance in chemistry and biology.[2] Moreover, they are also versatile substrates for organic transformations.[3] Over the past decades, the use of hypervalent alkynyliodonium salts as alkynylating agent[4] and the transition metal-catalyzed coupling of amides with alkynyl halides (eq 1)[5] or 1,1-dihalo-1-alkenes (eq 2)[6] as two general strategies have mainly been developed. However, halogenated substrates were required and halide byproducts were produced in these methods. Recent advances have been achieved by Stahl and co-workers[7] through the direct amidation of terminal alkynes using $O_2$ (1 atm) as oxidant (eq 3). In this approach, the catalyst loading was a little high, and dropwise addition of alkyne partners (over 4 h) and a large excess of amides were required to prevent the dimerization of alkynes (eq 3).[8]

---

[†] Peking University.

[‡] East China Normal University.

(1) For some reviews, see: (a) *Metal-Catalyzed Cross-Coupling Reactions*; de Meijere, A., Diederich, F., Eds.; Wiley-VCH: Weinheim, Germany, 2004. (b) Hartwig, J. F. *Acc. Chem. Res.* **2008**, *41*, 1534. (c) Martin, R.; Buchwald, S. L. *Acc. Chem. Res.* **2008**, *41*, 1461. (d) Beletskaya, I. P.; Cheprakov, A. V. *Coord. Chem. Rev.* **2004**, *248*, 2337. (e) Kunz, K.; Scholz, U.; Ganzer, D. *Synlett* **2003**, 2428. (f) Ley, S. V.; Thomas, A. W. *Angew. Chem., Int. Ed.* **2003**, *42*, 5400. (g) Chinchilla, R.; Nájera, C. *Chem. Rev.* **2007**, *107*, 874.

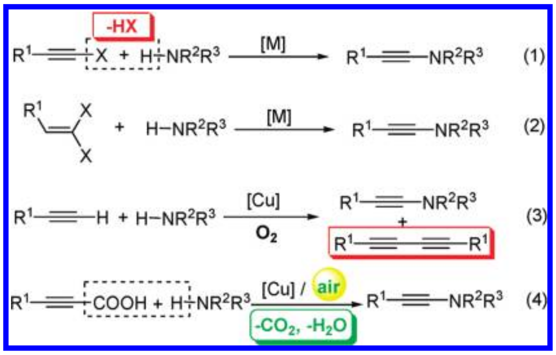
(2) For some reviews, see: (a) Tracey, M. R.; Hsung, R. P.; Antoline, J.; Kurtz, K. C. M.; Shen, L.; Slafer, B. W.; Zhang, Y. *Science of Synthesis: Houben-Weyl Methods of Molecular Transformations*; Weinreb, S. M., Ed.; Thieme: Stuttgart, Germany, 2005; Vol. 21, p 387. (b) Witulski, B.; Alayrac, C. *Science of Synthesis: Houben-Weyl Methods of Molecular Transformations*; de Meijere, A., Ed.; Thieme: Stuttgart, Germany, 2005; Vol. 24, p 1031. (c) Hsung, R. P.; Mulder, J. A.; Kurtz, K. C. M. *Synlett* **2003**, 1379. (d) Katritzky, A. R.; Jiang, R.; Singh, S. K. *Heterocycles* **2004**, *63*, 1455. (e) Zificsak, C. A.; Mulder, J. A.; Hsung, R. P.; Rameshkumar, C.; Wei, L.-L. *Tetrahedron* **2001**, *57*, 7575.

(3) For some recent examples, see: (a) Gourdet, B.; Lam, H. W. *J. Am. Chem. Soc.* **2009**, *131*, 3802. (b) Dooleweerdt, K.; Ruhland, T.; Skrydstrup, T. *Org. Lett.* **2009**, *11*, 221. (c) Zhang, Y.; DeKorver, K. A.; Lohse, A. G.; Zhang, Y.-S.; Huang, J.; Hsung, R. P. *Org. Lett.* **2009**, *11*, 899. (d) Alayrac, C.; Schollmeyer, D.; Witulski, B. *Chem. Commun.* **2009**, 1464. (e) Garcia, P.; Moulin, S.; Miclo, Y.; Leboeuf, D.; Gandon, V.; Aubert, C.; Malacria, M. *Chem.—Eur. J.* **2009**, *15*, 2129. (f) Sato, A.; Yorimitsu, H.; Oshima, K. *Synlett* **2009**, 28. (g) Zhang, X.; Hsung, R. P.; Li, H.; Zhang, Y.; Johnson, W. L.; Figueroa, R. *Org. Lett.* **2008**, *10*, 3477. (h) Kim, J. Y.; Kim, S. H.; Chang, S. *Tetrahedron Lett.* **2008**, *49*, 1745. (i) Oppenheimer, J.; Johnson, W. L.; Tracey, M. R.; Hsung, R. P.; Yao, P.-Y.; Liu, R.; Zhao, K. *Org. Lett.* **2007**, *9*, 2361. (j) Oppilliart, S.; Mousseau, G.; Zhang, L.; Jia, G.; Thuéry, P.; Rousseau, B.; Cintrat, J.-C. *Tetrahedron* **2007**, *63*, 8094. (k) Tanaka, K.; Takeishi, K.; Noguchi, K. *J. Am. Chem. Soc.* **2006**, *128*, 4586. (l) Couty, S.; Meyer, C.; Cossy, J. *Angew. Chem., Int. Ed.* **2006**, *45*, 6726. (m) Das, J. P.; Chechik, H.; Marek, I. *Nat. Chem.* **2009**, *1*, 128.

(4) (a) Witulski, B.; Stengel, T.; Fernández-Hernández, J. M. *Chem. Commun.* **2000**, 1965. (b) Witulski, B.; Gössmann, M. *Synlett* **2000**, 1793. (c) Rainier, J. D.; Imbriglio, J. E. *J. Org. Chem.* **2000**, *65*, 7272. (d) Witulski, B.; Gössmann, M. *Chem. Commun.* **1999**, 1879. (e) Witulski, B.; Stengel, T. *Angew. Chem., Int. Ed.* **1998**, *37*, 489.

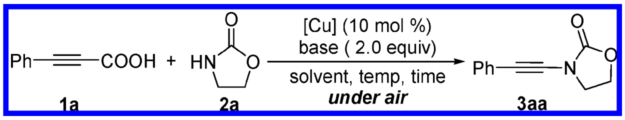
10.1021/ol1004615

Hence, the development of environmentally benign and efficient methods for C(sp)−N bond formation is still important for continued advancements in this area.



The importance of transition metal-catalyzed decarboxylative cross-coupling chemistry has grown rapidly in recent years.[9,10] We envisioned that decarboxylative cross-coupling perhaps can provide a novel and attractive approach for ynamides from amides and propiolic acids because (1) the carboxylic acids are readily available, easy to store, and simple to handle, (2) as opposed to organic halides, only carbon dioxide is produced as byproduct, and (3) the Glaser−Hay oxidative dimerization product diynes[8] (eq 3) could be efficiently inhibited, and the amides loading could be reduced. Herein, we demonstrate a novel copper-catalyzed oxidative decarboxylative amidation of propiolic acids leading to ynamides under air (eq 4).

**Table 1.** Cu-Catalyzed Oxidative Coupling of **1a** with **2a** via Decarboxylative Amidation[a]



| entry | Cu | base | solvent | temp (°C) | time (h) | yield of **3aa** (%)[b] |
|---|---|---|---|---|---|---|
| 1 | $CuCl_2$•$2H_2O$ | $K_2CO_3$ | toluene | 100 | 16 | 5 |
| 2 | $CuCl_2$•$2H_2O$ | $NaHCO_3$ | toluene | 100 | 2.5 | 28 |
| 3 | $CuCl_2$•$2H_2O$ | pyridine | toluene | 100 | 9 | 0 |
| 4 | $CuCl_2$•$2H_2O$ | $Cs_2CO_3$ | toluene | 100 | 19 | 0 |
| 5 | $CuCl_2$•$2H_2O$ | $Na_2CO_3$ | toluene | 100 | 12 | 83 |
| 6[c] | $CuCl_2$•$2H_2O$ | $Na_2CO_3$ | toluene | 100 | 12 | 47 |
| 7[d] | $CuCl_2$•$2H_2O$ | $Na_2CO_3$ | toluene | 100 | 16.5 | 69 |
| 8[e] | $CuCl_2$•$2H_2O$ | $Na_2CO_3$ | toluene | 100 | 13 | trace |
| 9 | $CuBr_2$ | $Na_2CO_3$ | toluene | 100 | 12 | 70 |
| 10 | $Cu(OAc)_2$•$H_2O$ | $Na_2CO_3$ | toluene | 100 | 12 | 68 |
| 11 | $CuSO_4$•$5H_2O$ | $Na_2CO_3$ | toluene | 100 | 12 | 66 |
| 12 | $Cu_2O$ | $Na_2CO_3$ | toluene | 100 | 12 | 56 |
| 13 | $CuCl_2$•$2H_2O$ | $Na_2CO_3$ | xylene | 90 | 12 | trace |
| 14 | $CuCl_2$•$2H_2O$ | $Na_2CO_3$ | $CH_3CN$ | reflux | 12 | 38 |
| 15 | $CuCl_2$•$2H_2O$ | $Na_2CO_3$ | benzene | reflux | 12 | 87 |
| 16 | $CuCl_2$•$2H_2O$ | $Na_2CO_3$ | toluene | reflux | 12 | 48 |

[a] General conditions: **1a** (0.2 mmol), **2a** (0.4 mmol), Cu (10 mol %), base (2.0 equiv), solvent (2 mL), under air. [b] Isolated yield. Homocoupled dimer product was observed in some reactions. [c] 5 mol % of $CuCl_2$•$2H_2O$ was employed. [d] The reaction was carried out in the presence of pyridine (20 mol %) as additive. [e] The reaction was carried out under $N_2$.

We initially paid attention to the decarboxylative cross-coupling of phenyl propiolic acid **1a** with 2-oxazolidinone **2a** catalyzed by inexpensive $CuCl_2$•$2H_2O$ in toluene under air (Table 1). Interestingly, the expected oxidative decarboxylative amidation product **3aa** was obtained in 5% yield in the presence of $K_2CO_3$ (Table 1, entry 1). When pyridine or $Cs_2CO_3$ was used in this reaction, the expected product **3aa** was not produced (Table 1, entries 3 and 4). Gratifyingly, 83% of **3aa** was achieved when $Na_2CO_3$ was employed as base (Table 1, entry 5). It is noteworthy that air participated as an ideal oxidant[11] to complete the catalytic cycle, which makes this approach more economical, readily handled, and practical. On the contrary, only a trace of **3aa** was produced when the reaction was carried out under $N_2$ (Table 1, entry 8). Attempts of using other copper catalysts such as $CuBr_2$,

---

(5) (a) Yao, B.; Liang, Z.; Niu, T.; Zhang, Y. *J. Org. Chem.* **2009**, *74*, 4630. (b) Dooleweerdt, K.; Birkedal, H.; Ruhland, T.; Skrydstrup, T. *J. Org. Chem.* **2008**, *73*, 9447. (c) Zhang, X.; Zhang, Y.; Huang, J.; Hsung, R. P.; Kurtz, K. C. M.; Oppenheimer, J.; Petersen, M. E.; Sagamanova, I. K.; Shen, L.; Tracey, M. R. *J. Org. Chem.* **2006**, *71*, 4170. (d) Zhang, Y.; Hsung, R. P.; Tracey, M. R.; Kurtz, K. C. M.; Vera, E. L. *Org. Lett.* **2004**, *6*, 1151. (e) Frederick, M. O.; Mulder, J. A.; Tracey, M. R.; Hsung, R. P.; Huang, J.; Kurtz, K. C. M.; Shen, L.; Douglas, C. J. *J. Am. Chem. Soc.* **2003**, *125*, 2368. (f) Dunetz, J. R.; Danheiser, R. L. *Org. Lett.* **2003**, *5*, 4011.

(6) Coste, A.; Karthikeyan, G.; Couty, F.; Evano, G. *Angew. Chem., Int. Ed.* **2009**, *48*, 4381.

(7) Hamada, T.; Ye, X.; Stahl, S. S. *J. Am. Chem. Soc.* **2008**, *130*, 833.

(8) For a review, see: Siemsen, P.; Livingston, R. C.; Diederich, F. *Angew. Chem., Int. Ed.* **2000**, *39*, 2632.

(9) For some reviews, see: (a) Goossen, L. J.; Rodríguez, N.; Goossen, K. *Angew. Chem., Int. Ed.* **2008**, *47*, 3100. (b) Baudoin, O. *Angew. Chem., Int. Ed.* **2007**, *46*, 1373. (c) You, S.-L.; Dai, L.-X. *Angew. Chem., Int. Ed.* **2006**, *45*, 5246. (d) Tunge, J. A.; Burger, E. *Eur. J. Org. Chem.* **2005**, 1715.

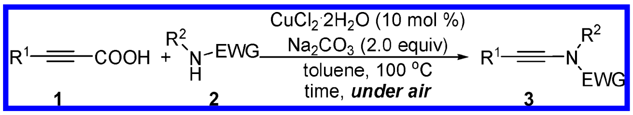
(10) For some selected examples, see: (a) Myers, A. G.; Tanaka, D.; Mannion, M. R. *J. Am. Chem. Soc.* **2002**, *124*, 11250. (b) Lalic, G.; Aloise, A. D.; Shair, M. D. *J. Am. Chem. Soc.* **2003**, *125*, 2852. (c) Lou, S.; Westbrook, J. A.; Schaus, S. E. *J. Am. Chem. Soc.* **2004**, *126*, 11440. (d) Tanaka, D.; Romeril, S. P.; Myers, A. G. *J. Am. Chem. Soc.* **2005**, *127*, 10323. (e) Rayabarapu, D. K.; Tunge, J. A. *J. Am. Chem. Soc.* **2005**, *127*, 13510. (f) Goossen, L. J.; Deng, G.; Levy, L. M. *Science* **2006**, *313*, 662. (g) Burger, E. C.; Tunge, J. A. *J. Am. Chem. Soc.* **2006**, *128*, 10002. (h) Forgione, P.; Brochu, M.-C.; St-Onge, M.; Thesen, K. H.; Bailey, M. D.; Bilodeau, F. *J. Am. Chem. Soc.* **2006**, *128*, 11350. (i) Waetzig, S. R.; Tunge, J. A. *J. Am. Chem. Soc.* **2007**, *129*, 4138. (j) He, H.; Zheng, X.-J.; Li, Y.; Dai, L.-X.; You, S.-L. *Org. Lett.* **2007**, *9*, 4339. (k) Goossen, L. J.; Zimmermann, B.; Knauber, T. *Angew. Chem., Int. Ed.* **2008**, *47*, 7103. (l) Goossen, L. J.; Rudolphi, F.; Oppel, C.; Rodríguez, N. *Angew. Chem., Int. Ed.* **2008**, *47*, 3043. (m) Goossen, L. J.; Rodríguez, N.; Linder, C. *J. Am. Chem. Soc.* **2008**, *130*, 15248. (n) Wang, C.; Tunge, J. A. *J. Am. Chem. Soc.* **2008**, *130*, 8118. (o) Moon, J.; Jeong, M.; Nam, H.; Ju, J.; Moon, J. H.; Jung, H. M.; Lee, S. *Org. Lett.* **2008**, *10*, 945. (p) Moon, J.; Jang, M.; Lee, S. *J. Org. Chem.* **2009**, *74*, 1403. (q) Yoshino, Y.; Kurahashi, T.; Matsubara, S. *J. Am. Chem. Soc.* **2009**, *131*, 7494. (r) Shang, R.; Fu, Y.; Li, J.-B.; Zhang, S.-L.; Guo, Q.-X.; Liu, L. *J. Am. Chem. Soc.* **2009**, *131*, 5738. (s) Wang, C.; Piel, I.; Glorius, F. *J. Am. Chem. Soc.* **2009**, *131*, 4194. (t) Bi, H.-P.; Zhao, L.; Liang, Y.-M.; Li, C.-J. *Angew. Chem., Int. Ed.* **2009**, *48*, 792. (u) Shang, R.; Fu, Y.; Wang, Y.; Xu, Q.; Yu, H.-Z.; Liu, L. *Angew. Chem., Int. Ed.* **2009**, *48*, 9350.

(11) For some examples with air as oxidant, see: (a) Chen, X.; Zhu, H.-Y.; Zhao, J.-C.; Zheng, Z.-F.; Gao, X.-P. *Angew. Chem., Int. Ed.* **2008**, *47*, 5353. (b) Kondo, J.; Shinokubo, H.; Oshima, K. *Angew. Chem., Int. Ed.* **2003**, *42*, 825. Dioxygen as an ideal oxidant has offered attractive industrial prospects in terms of green and sustainable chemistry, for some reviews see: (c) Costas, M.; Mehn, M. P.; Jensen, M. P., Jr.; Que, L. *Chem. Rev.* **2004**, *104*, 939. (d) Stahl, S. S. *Angew. Chem., Int. Ed.* **2004**, *43*, 3400. (e) Punniyamurthy, T.; Velusamy, S.; Iqbal, J. *Chem. Rev.* **2005**, *105*, 2329. (f) Popp, B. V.; Stahl, S. S. *Top. Organomet. Chem.* **2007**, *22*, 149.

$Cu(OAc)_2{\cdot}H_2O$, $CuSO_4{\cdot}5H_2O$, or $Cu_2O$ gave lower yields (Table 1, entries 9−12). After a great deal of screening on different parameters (see the Supporting Information), we found that the oxidative decarboxylative amidation catalyzed by $CuCl_2{\cdot}2H_2O$ (10 mol %) with $Na_2CO_3$ as base refluxed in benzene led to the highest efficiency (87% yield, Table 1, entry 15). As we expected, 2.0 equiv of amide **2a** loading efficiently completed this transformation, and the homocoupled dimer product was obviously inhibited (9%) (Table 1, entry 15). However, when the reaction was refluxed in toluene instead of benzene, **3aa** was obtained in only 48% yield, which is lower than that at 100 °C in toluene or refluxed in benzene (cf. entries 5, 15, and 16).

The scope of the transformation was further expanded to a variety of propiolic acids (Table 2). It is observed that aryl- and alkyl-substituted propiolic acids are good precoupling partners for this transformation (22−86% yield). Aryl propiolic acids with electron-donating substituents proceeded efficiently in good yields (Table 2, entries 1−4 and 9−12). Markedly, alkenyl-substituted propiolic acids such as (*E*)-5-phenylpent-4-en-2-ynoic acid **1f** underwent this transformation with **2a** and **2b** leading to **3fa** and **3fb**, respectively (Table 2, entries 5 and 13).

**Table 2.** Cu-Catalyzed Oxidative Decarboxylative Amidation of **1** with **2**[a]

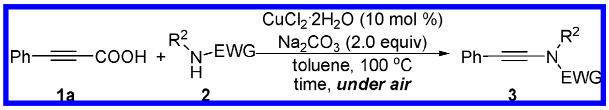


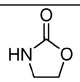
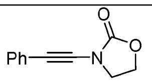
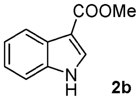
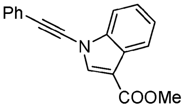
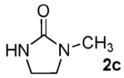
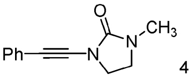
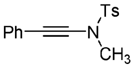
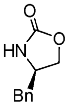
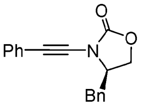
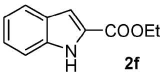
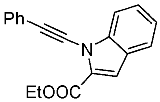
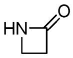
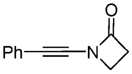
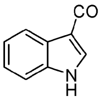
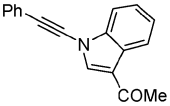
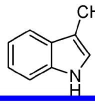
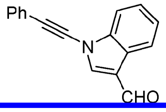
| entry | $R^1$ (**1**) | **2** | time (h) | yield of **3** (%)[b] |
|---|---|---|---|---|
| 1 | 4-MeO-$C_6H_4$− (**1b**) | **2a** | 28 | 84 (**3ba**) |
| 2 | 4-Me-$C_6H_4$− (**1c**) | | 28 | 76 (**3ca**) |
| 3 | 3-Me-$C_6H_4$− (**1d**) | | 26 | 75 (**3da**) |
| 4[c] | 3,4-$(MeO)_2$-$C_6H_3$− (**1e**) | | 46 | 86 (**3ea**) |
| 5[c] | (*E*)-PhCH= CH (**1f**) | | 24 | 42 (**3fa**) |
| 6 | *n*-Hep (**1g**) | | 12 | 65 (**3ga**) |
| 7 | *c*-Hex (**1h**) | | 20 | 65 (**3ha**) |
| 8[c] | 2-furyl− (**1i**) | | 26 | 22 (**3ia**) |
| 9[d] | 4-MeO-$C_6H_4$− (**1b**) | **2b** | 48 | 70 (**3bb**) |
| 10[d] | 4-Me-$C_6H_4$− (**1c**) | | 31 | 61 (**3cb**) |
| 11[d] | 3-Me-$C_6H_4$− (**1d**) | | 26 | 66 (**3db**) |
| 12[c,d] | 3,4-$(MeO)_2$-$C_6H_3$− (**1e**) | | 48 | 65 (**3eb**) |
| 13[c,d] | (*E*)-PhCH-CH− (**1f**) | | 60 | 34 (**3fb**) |
| 14[d] | *n*-Hep (**1g**) | | 26 | 75 (**3gb**) |
| 15[c,d] | *c*-Hex (**1h**) | | 27 | 79 (**3hb**) |
| 16[c,d] | 2-furyl− (**1i**) | | 48 | 22 (**3ib**) |
| 17[d] | *i*-Pr (**1j**) | | 36 | 44 (**3jb**) |

[a] General conditions: **1** (0.2 mmol), **2** (0.4 mmol), $CuCl_2{\cdot}2H_2O$ (10 mol %), $Na_2CO_3$ (2.0 equiv), toluene (2 mL), 100 °C, under air. [b] Isolated yield. Homocoupled dimer product was observed in some reactions but in low yield. [c] The reaction was refluxed in benzene. [d] The reaction was carried out in the presence of pyridine (2.0 equiv) as additive.

Under the optimal reaction conditions, different amides such as nitrogen nucleophiles were investigated (Table 3). Oxazolidinones and indoles with electron-withdrawing groups at the 2- or 3-position converted to the desired ynamides efficiently in good yields (Table 3, entries 1−2 and 5−6). Imidazolidinones were tolerated in this transformation. When **2c** was used as nitrogen nucleophile, the expected **3ac** was obtained in 48% yield (Table 3, entry 3). Moreover, an acyclic nitrogen nucleophile such as *N*-methyl benzensulfonamide **2d** could successfully be transformed into **3ad**, but with lower yield (Table 3, entry 4).

**Table 3.** Cu-Catalyzed Oxidative Decarboxylative Amidation of **1a** with Different Amides **2**[a]



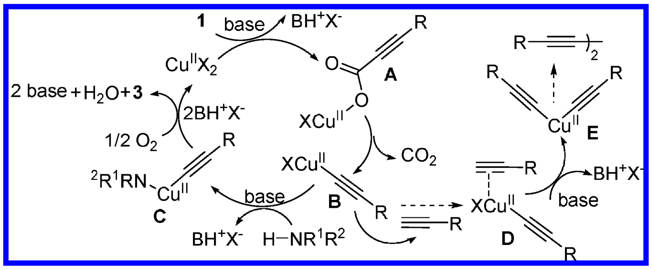
| entry | $R_2$–NH−EWG | | time (h) | yield of **3** (%)[b] | |
|---|---|---|---|---|---|
| 1 |  | **2a** | 12 |  | 83 (**3aa**) |
| 2[c] |  | **2b** | 20 |  | 68 (**3ab**) |
| 3 |  | **2c** | 17 |  | 48 (**3ac**) |
| 4 | $CH_3NHTs$ | **2d** | 31 |  | 32(**3ad**) |
| 5 |  | **2e** | 12 |  | 68 (**3ae**) |
| 6[c] |  | **2f** | 47 |  | 56 (**3af**) |
| 7[d] |  | **2g** | 22 |  | 33 (**3ag**) |
| 8[c,d] |  | **2h** | 41 |  | 39 (**3ah**) |
| 9[c] |  | **2i** | 29 |  | 39 (**3ai**) |

[a] General conditions: **1a** (0.2 mmol), **2** (0.4 mmol), $CuCl_2{\cdot}2H_2O$ (10 mol %), $Na_2CO_3$ (2.0 equiv), toluene (2 mL), 100 °C, under air. [b] Isolated yield. Homocoupled dimer product was observed in some reactions but in low yield. [c] The reaction was carried out in the presence of pyridine (2.0 equiv) as additive. [d] The reaction was refluxed in benzene.

A plausible mechanism for the transformation of **1** with amide **2** is illustrated in Scheme 1. The copper(II) intermediates **A** are initially formed, which undergo decarboxylation to produce the alkynyl copper(II) intermediates **B**. Nucleophilic attack by amide **2** affords the $Cu^{II}$(alkynyl)(amidate) intermediates **C**, followed by C−N reductive elimination leading to the expected products **3**. Cu catalyst was then reoxidized by dioxygen to fulfill the catalytic cycle.

We hypothesize that the reason for the reduction of diynes formation is probably due to the absence of abundant alkynes in this catalytic system in which propiolic acids were

**Scheme 1.** A Proposed Mechanism for the Direct Transformation



employed as precoupling partners. Hence, the bis-alkynyl-Cu(II) intermediate **E**,[7] which would result in the undesired diyne byproduct, could not be efficiently formed (Scheme 1).

In summary, we have developed a novel Cu-catalyzed aerobic oxidative amidation of propiolic acids via decarboxylation under air. To the best of our knowledge, this is the first intermolecular sp-carbon−heteroatom bond formation via decarboxylation. The use of propiolic acid derivatives, which are readily available, easy to store, and simple to handle, as the coupling partner efficiently inhibits the formation of dimerization product diynes, as well as reduces the loading of the catalyst and the amide nucleophiles. Moreover, as opposed to organic halides, only carbon dioxide is produced as byproduct in this approach. The use of air as oxidant makes this method more attractive not only for academic research, but also for industrial application. Further studies on the reaction scope and synthetic applications are ongoing in our group.

**Acknowledgment.** This paper is dedicated to the memory of Professor Xian Huang. Financial support from Peking University, National Science Foundation of China (Nos. 20702002 and 20872003) and National Basic Research Program of China (973 Program) (Grant No. 2009CB825300) is greatly appreciated. We thank Si Li in this group for reproducing the results of entries 2 and 5 in Table 2.

**Supporting Information Available:** Experimental details and NMR spectra. This material is available free of charge via the Internet at http://pubs.acs.org.

OL1004615