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Benzylic C-H Heteroarylation of *N*-(Benzyloxy)phthalimides with Cyanopyridines Enabled by Photoredox 1,2-Hydrogen Atom Transfer

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A visible light initiated α-C(sp^3)-H arylation of *N*-(benzyloxy)phthalimides with cyanopyridines for the construction of highly valuable pyridinyl-containing diarylmethanols, including bioactive motif-based analogues, is reported. This method enables arylation of the C(sp^3)-H bonds adjacent to an oxygen atom through alkoxy radical formation by O-N bond cleavage, 1,2-hydrogen atom transfer (HAT), arylation and C-CN bond cleavage cascades, and offers a means to exploitation of 1,2-HAT modes to incorporate functional groups for constructing functionalized alcohols.

Diarylmethanols, especially variants possessing heteroaryls, are important core structural motifs in bioactive natural products, pharmaceuticals and materials.[1] Accordingly, substantial efforts have been paid to the discovery of efficient strategies to prepare diarylmethanols.[2-4] General methods for their synthesis include addition of aryl nucleophiles (e.g., aryl organometallic reagents) to aryl carbonyl compounds[2] and reduction of diaryl ketone derivatives.[3] Despite impressive progress in the field, the known transformations have some disadvantages, such as limited substrate scope, unsatisfactory selectivity, and the generation of a stoichiometric amount of chemical waste. Furthermore, the construction of heteroaryl-containing diarylmethanol scaffolds, especially nonsymmetric ones, has been sporadically documented in a few papers and is an even great challenge, with most concerning addition of heteroaryl- metallic reagents to the carbonyl compounds. Thus, the development of general and sustainable routes toward diarylmethanols, especially nonsymmetric heteroaryl-containing diarylmethanols, is highly desirable and urgent.

Recent advances have showed the C(sp^3)-H radical functionalization reaction enabled by a hydrogen atom transfer (HAT) process represents a new synthetic alternative to ionic reactions for increasing molecular complexity.[5] Typical strategies involve radical functionalization of the C(sp^3)-H bonds in alcohols and their derivatives,[6-7] which is achieved by the formation of alkoxyl radical intermediate followed by HAT, featuring high efficiency and excellent site-selectivity (Scheme 1a upper). However, only a few papers that employ the HAT strategy to site-selectively introduce a functional group to the C(sp^3)-H bonds in alcohols and their derivatives have been reported, and the most commonly explored transformations relied on 1,5-HAT.[6] At present, approaches via 1,2-HAT have been significantly less investigated,[7] which mainly focus on direct conversion of the hydroxy group to the carbonyl group (e.g., aldehydes, ketones).[7a-l] Very recently, Lan, Chen and co-workers[7n] have reported a new 1,2-HAT strategy for α-allylation of *N*-(alkyloxy)phthalimides for the synthesis of allyl alcohols beyond the formation of carbonyl compounds wherein visible light induced transformation of the C(sp^3)-H bonds adjacent to an oxygen atom to the alkoxyl radical followed by 1,2-HAT and allylation (Scheme 1a lower). Although only a special ethyl 2-((phenylsulfonyl)methyl)acrylate as the external functional reagent was used to accomplish this α-C(sp^3)-H allylation, we envisioned that employing visible light sensitive functional reagents, such as heteroaryl-based reagents, would allow the functionalization of α-C(sp^3)-H bonds of *N*-(alkyloxy)phthalimides via 1,2-HAT to access functionalized methanol derivatives.

Herein, we report a new strategy for producing pyridinyl-containing diarylmethanols via α-C(sp^3)-H arylation of *N*-(benzyloxy)phthalimides with cyanopyridines[8] enabled by the visible light photoredox catalysis (Scheme 1b). Visible light-induced cleavage of the O-N bond results in the formation of benzyloxy radical is crucial, allowing 1,2-HAT and arylation cascades to access highly valuable nonsymmetric diarylmethanols, including bioactive motif-based analogues.

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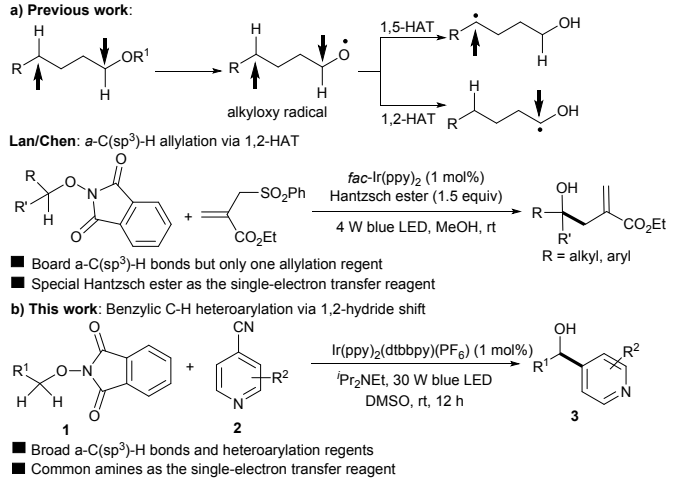
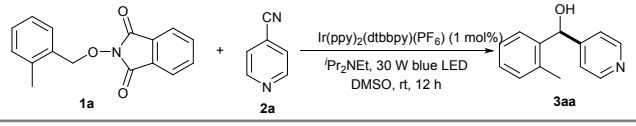


Scheme 1. Hydrogen Atom Transfer of Alkoxy Radicals.

We initiated our study with optimization of conditions for the α-C(sp^3)-H arylation of *N*-((2-methylbenzyloxy)phthalimide **1a** with isonicotinonitrile **2a** (Table 1). We found that substrate **1a** reacted with nitrile **2a**, 1 mol% of $Ir(ppy)_2(dtbbpy)(PF_6)$ and 2.2 equiv of $^iPr_2NEt$ in DMSO under argon atmosphere and 30 W blue LED light at room temperature was optimal, affording the desired product **3aa** in 90% yield (entry 1). These parameters, Ir photocatalyst, organic base and additional visible light, were proved to be crucial because omission of each resulted in no reaction (entries 2, 6 and 14). However, the common $Ir(ppy)_3$ exhibited lower reactivity (entry 3), and both $Ru(bpy)_3Cl_2$ and Eosin Y had no catalytic activity (entries 4-5). While organic bases (e.g., $^iPr_2NEt$, Et_3N) were the key to initiate the reaction (entries 1, 6 and 7), inorganic bases (e.g., K_3PO_4, K_2CO_3) were inert (entries 8-9). The results suggest that organic bases may act as single-electron transfer reagents. Three other solvents, DMF, MeCN and MeOH, both were inferior to DMSO (entries 10-12). A higher temperature (40 °C) had no obvious improvement on yield (entry 13). No reaction was observed in dark (entry 14). The desired product **3aa** was obtained in 32% yield when using extra dry DMSO, indicating that the water assisted this process (entry 15). Strikingly, the reaction with 1 mmol scale of **1a** proceeded efficiently, giving **3aa** in 85% yield (entry 16).

Table 1 Optimization of the Reaction Conditions[a]

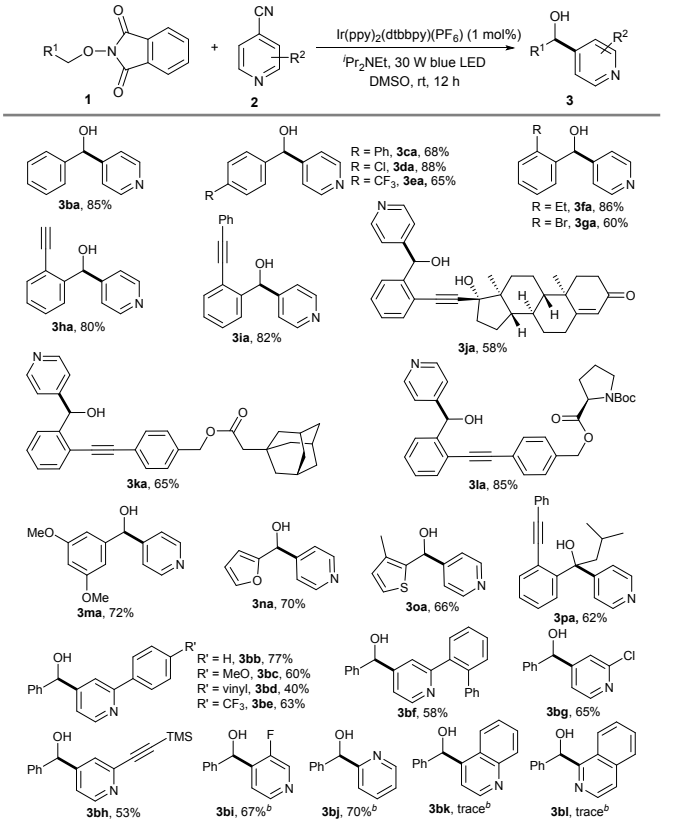


Entry	Variation from the standard conditions	Yield (%)
1	none	90
2	without $Ir(ppy)_2(dtbbpy)(PF_6)$	0
3	$Ir(ppy)_3$ instead of $Ir(ppy)_2(dtbbpy)(PF_6)$	9
4	$Ru(bpy)_3Cl_2$ instead of $Ir(ppy)_2(dtbbpy)(PF_6)$	trace
5	Eosin Y instead of $Ir(ppy)_2(dtbbpy)(PF_6)$	trace
6	without $^iPr_2NEt$	trace
7	Et_3N instead of $^iPr_2NEt$	70
8	K_3PO_4 instead of $^iPr_2NEt$	trace
9	K_2CO_3 instead of $^iPr_2NEt$	trace
10	DMF instead of DMSO	53
11	MeCN instead of DMSO	60
12	MeOH instead of DMSO	52
13	at 40 °C	87
14	in dark	0
15	extra dry DMSO	32
16[b]	none	85

[a] Reaction conditions: **1a** (0.2 mmol), **2a** (2 equiv), $Ir(ppy)_2(dtbbpy)(PF_6)$ (1 mol%), $^iPr_2NEt$ (2.2 equiv), DMSO (2 mL), argon, 30 W blue LED light, room temperature and 12 h. [b] **1a** (1 mmol).

We next evaluated the substrate scope of this benzylic C-H heteroarylation protocol (Table 2). The optimized conditions were compatible with a wide range of *N*-(benzyloxy)phthalimides **1** (**3ba-oa**). Treatment of substrate **1b** was converted efficiently to **3ba** in 85% yield. Several substituents, including Ph, Cl, CF_3, Me, Br and various ethynyl groups, on the aryl ring of the benzyloxy moiety were well tolerated (**3ba-la**), and the electronic property affected the reactivity. While substrates **1a** and **1f** bearing an *ortho*-electron-donating group (e.g., Me, Et) furnished **3aa** and **3fa** in excellent yields, substrate **1e** having a *para*-electron-withdrawing CF_3 group delivered **3ea** in moderate yield. Halogen groups (e.g., Cl, Br) were tolerated,

Table 2. Variation of the *N*-(Alkyloxy)phthalimides (**1**) and Isonicotinonitrile Derivatives (**2**)[a]



[a] Reaction conditions: **1** (0.2 mmol), **2** (2 equiv), $Ir(ppy)_2(dtbbpy)(PF_6)$ (1 mol%), $^iPr_2NEt$ (2.2 equiv), DMSO (2 mL), argon, 30 W blue LED light, room temperature and 12 h. [b]

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For 24 h.

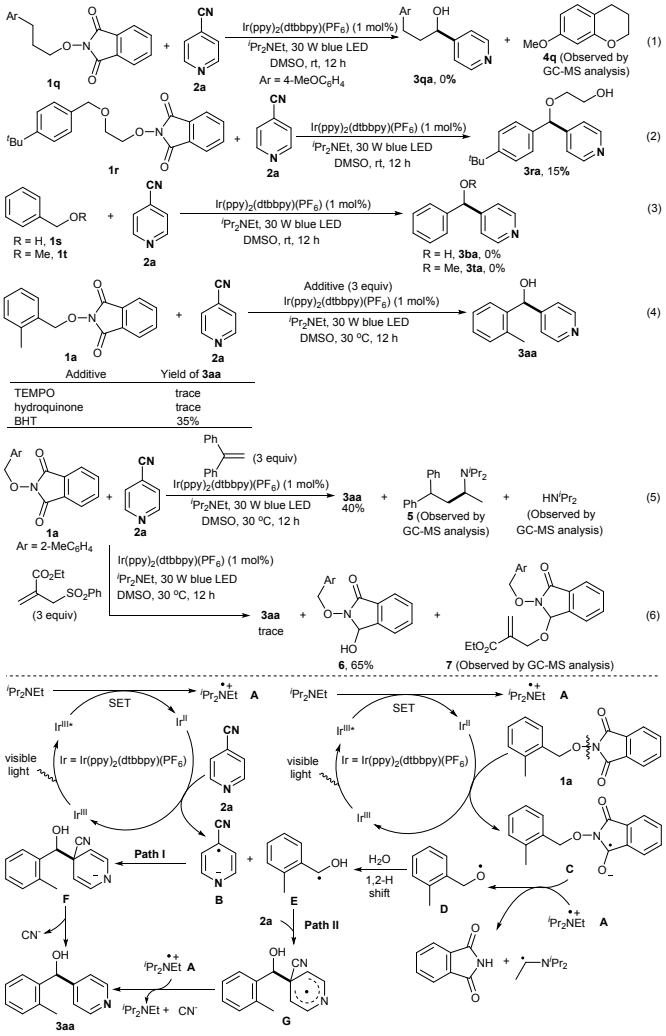
thus offering potential in the late stage modification (**3da, 3ga**). Terminal and internal alkynes **1h-l** were well tolerated (**3ha-la**), making the protocol more attractive in synthesis. Notably, this protocol was applicable to the incorporation of the important pharmacophore cores,[9] including ethisterone, adamantane and proline motifs, into the diarylmethanol frameworks (**3ja-la**), thereby providing a vistas for the translational potential of this protocol in pharmaceutically relevant field. Heteroaryl (e.g., furan-2-yl, 3-methylthiophen- 2-yl) possessing substrates **1n-o** were viable for furnishing nonsymmetrical diheteroarylmethanols **3na-oa**. Delightedly, tertiary alcohols **3pa** could be constructed in moderate yield.

The optimized conditions were general for benzylic C-H heteroarylation with various cyanopyridines (**3bb-bj**). A number of substituents, such as Ph, 4-$MeOC_6H_4$, 4-vinylC_6H_4, 4-$MeOC_6H_4$, 4-$CF_3C_6H_4$, 4-PhC_6H_4, Cl and (trimethylsilyl)ethynyl, at 2 position of the pyridine ring were accommodated, affording **3bb-bh** in moderate to good yields. Using 3-F-4-cyanopyridine **2i** delivered **3bi** smoothly in 67% yield. Gratifyingly, 2-cyanopyridine **2j** also underwent the benzylic C-H heteroarylation successfully (**3bj**). However, both quinoline-4-carbonitrile **2k** and isoquinoline-1-carbonitrile **2l** were unsuitable substrates (**3bk-bl**).

As shown in Scheme 2, using 2-(3-(4-methoxyphenyl)-propoxy)isoindoline-1,3-dione **1q** gave the intramolecular cyclization product **4q**, not the desired product **3qa** (Eq 1). For 2-(2-((4-(*tert*-butyl)benzyl)-oxy)ethoxy)isoindoline-1,3-dione **1r** the 1,5-HAT reaction occurred to afford **3ra** (Eq 2). The results suggest that this current protocol includes a HAT process, and the alkyl chain of the *N*-(alkyloxy) moiety affects the chemoselectivity. However, both benzyl alcohol **1s** and benzyl methyl ether **1t** were not suitable substrates (Eq 3), implying that generation of the alkoxy radical requires the phthalimide group to assist it. The reaction of substrate **1a** with **2a** was inhibited by a radical scavenger, TEMPO, hyroquinone, 2,6-di-*tert*-butyl-4-methyl-phenol (BHT) (Eq 4), 1,1-diphenylalkene (Eq 5) or ethyl 2-((phenylsulfonyl)methyl)acrylate[7n] (Eq 6). Notably, the reaction was inhibited by 1,1-diphenylalkene attributing to reaction with ^{i}Pr$_2$NEt to form **5** and ^{i}Pr$_2$NH, and was suppressed by 2-((phenylsulfonyl)methyl)acrylate due to its direct reaction with both ^{i}Pr$_2$NEt and **1a** leading to **6** and **7**, suggesting a different mechanism from the results of Lan/Chen group[7n] and verifying ^{i}Pr$_2$NEt as the single-electron transfer reagent. The light turn/off experiments support this current protocol *via* visible light photoredox catalysis (Figure S2; Supplementary Information).

The possible mechanisms for this α-C(sp^3)-H arylation protocol were proposed (Scheme 2).[5-8] The Ir^{III}* excited state is formed from the Ir^{III} species under blue LED light, followed by reduction with ^{i}Pr$_2$NEt to afford the active Ir^{II} species and the ^{i}Pr$_2$NEt radical cation **A**. The single electron reduction (SER) of 4-cyanopyridine **2a** by the active Ir^{II} species delivers the 4-cyanopyridine radical anion **B**[8m] and regenerates the Ir^{III} species.[8] Meanwhile, the SER of *N*-((2-methylbenzyloxy)phthalimide **1a** by the active Ir^{II} species yields the radical intermediate **C** and then reaction with the radical cation **A** forms the benzyloxy radical **D**.[7n] The radical **D** undergoes 1,2-HAT assisted by H_2O to form the benzyl carbon-centered radical **E** (also supported the results of entry 12; Table 1).[7d,7k] The cross coupling between the radical **B** and the radical **E** offers the intermediate **F** (Path I),[8] which sequentially undergoes cleavage of C-CN bonds to afford the desired product **3aa**.

we cannot rule out Path II wherein the direct addition of the radical **E** to **2a** to form the intermediate **G**, followed by single electron reduction by the radical cation **A** and C-CN bond cleavage to afford product **3aa**.



Scheme 2. Other *N*-(Alkyloxy)phthalimides **1**, Control Experiments and Possible Mechanisms.

In summary, we have developed a novel, general and robust method for the α-C(sp^3)-H arylation of *N*-(alkyloxy)- phthalimides with readily accessible cyanopyridines as the pyridinyl group resources through a visible light photoredox-enabled 1,2-HAT of the alkoxy radical process. The use of both a blue-light-sensitized Ir(ppy)$_2$(dtbbpy)(PF$_6$) photocatalyst and an organic base was crucial for accomplishment of the α-C(sp^3)-H arylation reaction with high efficiency and excellent selectivity. This method allows transformation of various *N*-(alkyloxy)phthalimides and cyanopyridines to highly valuable pyridinyl-containing diarylmethanols, including bioactive motif-based analogues, by a sequence of the O-N bond cleavage, 1,2-HAT, arylation and C-CN bond cleavage, and can be expected as a versatile strategic design to other type of two radical cross coupling via 1,2-HAT.

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Conflict of interest

There are no conflicts to declare.

Notes and references

1 For selected papers, see: (*a*) T. Miki, M. Kori, H. Mabuchi, R. Tozawa, T. Nishimoto, Y. Sugiyama, K. Teshima and H. Yukimasa, *J. Med. Chem.,* 2002, **45**, 4571; (*b*) T. Nishimura, H. Taji and N. Harada, *Chirality,* 2004, **16**, 13; (*c*) R. H. Shoemaker, *Nat. Rev. Cancer,* 2006, **6**, 813; (*d*) K. A. Lyseng-Williamson, *Drugs,* 2010, **70**, 1579; (*e*) L. Yin, Q. Hu, R. W. Hartmann, *J. Med. Chem.,* 2013, **56**, 460.

2 (*a*) C. Defieber and E. M. Carreira, *Modern Arylations of Carbonyl Compounds,* Ackermann, L. Ed., WILEY-VCH Verlag GmbH & Co. KGaA: Weinheim, 2009, pp. 271-309. (*b*) F. Schmidt, R. T. Stemmler, J. Rudolph and C. Bolm, *Chem. Soc. Rev.,* 2006, **35**, 454; (*c*) F. Luo, C. Pan and J. Cheng, *Chin. J. Org. Chem.,* 2010, **30**, 633; (*d*) S. Mondal and G. Panda, *RSC Adv.,* 2014, **4**, 28317; (*e*) S. Mondal, D. Roy and G. Panda, *Tetrahedron,* 2018, **74**, 4619.

3 (*a*) *Handbook of Homogeneous Hydrogenation*, (Eds: De Vries, G.; Elsevier, C. J.), Wiley-VCH, Weinheim, 2007; (*b*) D. J. Edmonds, D. Johnston and D. J. Procter, *Chem. Rev.,* 2004, **104**, 3371; (*c*) R. A. II. Flowers, *Synlett,* 2008, **10**, 1427; (*d*) B. T. Cho, *Chem. Soc. Rev.,* 2009, **38**, 443; (*e*) D. Wang and D. Astruc, *Chem. Rev.,* 2015, **115**, 6621; (*f*) F. Meemken and A. Baiker, *Chem. Rev.,* 2017, **117**, 11522; (*g*) G. A. Filonenko, R. van Putten, E. J. M. Hensen and E. A. Pidko, *Chem. Soc. Rev.,* 2018, **47**, 1459; (*h*) Z. Zhang, N. A. Butt, M. Zhou, D. Liu and W. Zhang, *Chin. J. Chem.,* 2018, **36**, 443.

4 (*a*) L. Zhang, B. Tu, M. Ge, Y. Li, L. Chen, W. Wang and S. Zhou, *J. Org. Chem.,* 2015, **80**, 8307, and references cited therein; (*b*) A. R. Rivero, B.-S. Kim and P. J. Walsh, *Org. Lett.,* 2016, **18**, 1590; (*c*) Z. Liu, X. Nan, T. Lei, C. Zhou, Y. Wang, W. Liu, B. Chen, C. Tung and L. Wu, *Chin. J. Catal.,* 2018, **39**, 487.

5 For recent reviews see: (*a*) K. Jia and Y. Chen, *Chem. Commun.,* 2018, **54**, 6105; (*b*) J.-J. Guo, A. Hu and Z. Zuo, *Tetrahedron Lett.,* 2018, **59**, 2103; (*c*) L. Kong, Y. Zhou, F. Luo and G. Zhu, *Chin. J. Org. Chem.,* 2018, **38**, 2858; (*d*) X. Wu and C. Zhu, *Chin. J. Chem.,* 2019, **37**, 171; (*e*) X. Wu and C. Zhu, *Chem. Commun.,* 2019, **55**, 9747; (*f*) D. Leifert and A. Studer, *Angew. Chem. Int. Ed.,* 2019, **58**, 2.

6 For representative papers, see: (*a*) A. E. Dorigo and K. N. Houk, *J. Org. Chem.,* 1988, **53**, 1650; (*b*) J. Hartung, *Eur. J. Org. Chem.,* 2001, **4**, 619; (*c*) Ž. Čeković, *Tetrahedron,* 2003, **59**, 8073; (*d*) S. Chiba and H. Chen, *Org. Biomol. Chem.,* 2014, **12**, 4051; (*e*) H. Zhu, J. G. Wickenden, N. E. Campbell, J. C. Leung, K. M. Johnson and G. M. Sammis, *Org. Lett.,* 2009, **11**, 2019; (*f*) H. Zhu, J. C. Leung and G. M. Sammis, *J. Org. Chem.,* 2015, **80**, 965; (*g*) M. Rueda-Becerril, J. C. T. Leung, C. R. Dunbar and G. M. Sammis, *J. Org. Chem.,* **2011**, **76**, 7720; (*h*) J. Zhang, Y. Li, F. Zhang, C. Hu and Y. Chen, *Angew. Chem. Int. Ed.,* 2016, **55**, 1872; (*i*) A. Hu, J. J. Guo, H. Pan, H. Tang, Z. Gao and Z. Zuo, *J. Am. Chem. Soc.,* 2018, **140**, 1612; (*j*) X. Wu, M. Wang, L. Huan, D. Wang, J. Wang and C. Zhu, *Angew. Chem. Int. Ed.,* 2018, **57**, 1640; (*k*) X. Wu, H. Zhang, N. Tang, Z. Wu, D. Wang, M. Ji, Y. Xu, M. Wang and C. Zhu, *Nat. Commun.,* 2018, **9**, 3343; (*l*) H. Guan, S. Sun, Y. Mao, L. Chen, R. Lu, J. Huang and L. Liu, *Angew. Chem. Int. Ed.,* 2018, **57**, 11413; (*m*) M. Wang, L. Huan and C. Zhu, *Org. Lett.,* 2019, **21**, 821. (*n*) J. Zhang, Y. Li, F. Zhang, C. Hu and Y. Chen, *Angew. Chem. Int. Ed.,* 2016, **55**, 1872.

7 (*a*) B. C. Gilbert, R. G. G. Holmes, H. A. H. Laue and R. O. Norman, C. *J. Chem. Soc. Perkin Trans. 2,* 1976, 1047; (*b*) P. E. Elford and B. P. Roberts, *J. Chem. Soc. Perkin Trans. 2*, 1996, 2247; (*c*) E. Baciocchi, M. Bietti and S. Steenken, *J. Am. Chem. Soc.,* 1997, **119**, 4078; (*d*) K. G. Konya, T. Paul, S. Q. Lin, J. Lusztyk and K. U. Ingold, *J. Am. Chem. Soc.,* 2000, **122**, 7518; (*e*) A. Fernández-Ramos and M. Z. Zgierski, *J. Phys. Chem. A,* 2002, **106**, 10578; (*f*) R. J. Buszek, A. Sinha, J. S. Francisco, *J. Am. Chem. Soc.,* 2011, **133**, 2013; (*g*) C. Che, Q. Huang, H. Zheng and G. Zhu, *Chem. Sci.,* 2016, **7**, 4134; (*h*) H. Zhu, X. Nie, Q. Huang and G. Zhu, *Tetrahedron Lett.,* 2016, **57**, 2331; (*i*) Z. Liu, Y. Bai, J. Zhang, Y. Yu, Z. Tan and G. Zhu, *Chem. Commun.,* 2017, **53**, 6440; (*j*) D. Lu, Y. Wan, L. Kong and G. Zhu, *Org. Lett.,* 2017, **19**, 2929; (*k*) C. Che, Z. Qian, M. Wu, Y. Zhao and G. Zhu, *J. Org. Chem.,* 2018, **83**, 5665; (*l*) C. Wang, Y. Yu, W.-L. Liu and W.-L. Duan, *Org. Lett.,* 2019, **21**, 9147; (*m*) L. Niu, J. Liu, X. Liang, S. Wang and A. Lei, *Nat. Commun.,* 2019, **10**, 467; (*n*) J. Zhang, D. Liu, S. Liu, Y. Ge, Y. Lan and Y. Chen, *iScience,* 2020, **23**, 100755.

8 For representative papers on use of cyanopyridines as the aryl reagents, see: (*a*) A. McNally, C. K. Prier and D. W. C. MacMillan, *Science,* 2011, **334**, 1114; (*b*) M. T. Pirnot, D. A. Rankic, D. B. C. Martin and D. W. C. MacMillan, *Science,* 2013, **339**, 1593; (*c*) T. Hoshikawa and M. Inoue, *Chem. Sci.,* 2013, **4**, 3118; (*d*) K. Qvortrup, D. A. Rankic and D. W. C. MacMillan, *J. Am. Chem. Soc.,* 2014, **136**, 626; (*e*) Z. Zuo and D. W. C. MacMillan, *J. Am. Chem. Soc.,* 2014, **136**, 5257; (*f*) J. D. Cuthbertson and D. W. C. MacMillan, *Nature,* 2015, **519**, 74; (*g*) B. Lipp, A. M. Nauth and T. Opatz, *J. Org. Chem.,* 2016, **81**, 6875; (*h*) C. Yan, L. Li, Y. Liu and Q. Wang, *Org. Lett.,* 2016, **18**, 4686; (*i*) B. Lipp, A. Lipp, H. Detert and T. Opatz, *Org. Lett.,* 2017, **19**, 2054; (*j*) J. A. Vega, J. M. Alonso, G. Mendez, M. Ciordia, F. Delgado and A. A. Trabanco, *Org. Lett.,* 2017, **19**, 938; (*k*) Y. Lei, J. Yang, R. Qi, S. Wang, R. Wang and Z. Xu, *Chem. Commun.,* 2018, **54**, 11881; (*l*) T. Ide, J. P. Barham, M. Fujita, Y. Kawato, H. Egami and Y. Hamashima, *Chem. Sci.,* 2018, **9**, 8453; (*m*) L. Gao, G. Wang, J. Cao, H. Chen, Y. Gu, X. Liu, X. Cheng, J. Ma and S. Li, *ACS Catal.,* 2019, **9**, 10142; (*n*) J. Cao, G. Wang, L. Gao, H. Chen, X. Liu, X. Cheng and S. Li, *Chem. Sci.,* 2019, **10**, 2767; (*o*) M. Miao, L. L. Liao, G. M. Cao, W. J. Zhou and D. G. Yu, *Sci. China Chem*., 2019, **62**, 1519; (*p*) Y. Chen, P. Lu and Y. Wang, *Org. Lett.,* 2019, **21**, 2130.

9 (*a*) X. Teng, S. Maksimuk, S. Frommer and H. Yang, *Chem. Mater.,* 2007, **19**, 36; (*b*) H. Elayadi and H. B. Lazrek, *Nucleosides, Nucleotides Nucleic Acids,* 2015, **34**, 433; (*c*) D. Alberti, A. Toppino, S. G. Crich, C. Meraldi, C. Prandi, N. Protti, S. Bortolussi, S. Altieri, S. Aimea and A. Deagostino, *Org. Biomol. Chem.,* 2014, **12**, 2457.

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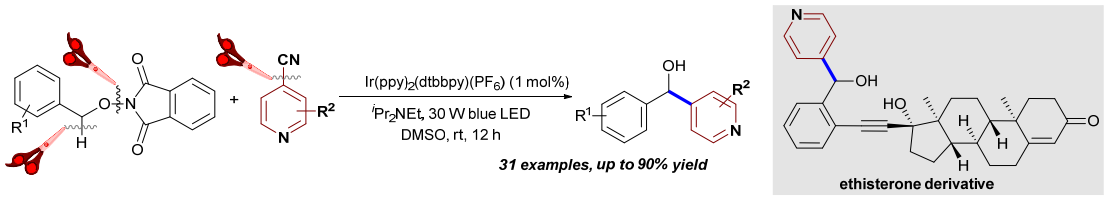
Benzylic C-H Heteroarylation of *N*-(Benzyloxy)phthalimides with Cyanopyridines Enabled by Photoredox 1,2-Hydrogen Atom Transfer

Long-Jin Zhong, Hong-Yu Wang, Xuan-Hui Ouyang,* Jin-Heng Li,* and De-Lie An*



Visible light initiated α-C(sp^3)-H hetroarylation of *N*-(benzyloxy)phthalimides with cyanopyridines via 1,2-hydrogen atom transfer is depicted.