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Journal Name

## COMMUNICATION

# Light-Mediated Cascade Transformation of Activated Alkenes: BiOBr Nanosheets as Efficient Photocatalysts for the Synthesis of $\alpha$ -aryl- $\beta$ -trifluoromethyl Amides

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**A facile light-induced, BiOBr nanosheets promoted one-pot tandem transformation of activated alkenes is presented. A wide variety of acyclic  $\alpha$ -aryl- $\beta$ -trifluoromethyl amides are synthesized via the consecutive trifluoromethylation/aryl migration/desulfonylation and N-H bond formation process.**

Tandem or cascade transformation has been proved to be an efficient and atom economic strategy in organic synthesis as it enables a rapid increase in molecular complexity from readily available starting materials.<sup>1</sup> Additionally, the advantage of such transformation is the simultaneous formation of two or more bonds in a single manipulation process. Alkenes are privileged motifs for tandem reactions and have been intensively studied to date. However, transformations involving construction of C-CF<sub>3</sub> bonds are still limited to halotrifluoromethylation,<sup>2</sup> hydrotrifluoromethylation,<sup>3</sup> aminotrifluoromethylation,<sup>4</sup> and oxytrifluoromethylation.<sup>5</sup> Recently, aryltrifluoromethylation of alkenes has spurred intense interest from synthetic chemists.<sup>6</sup> Following the pioneering work of Liu and co-workers,<sup>7</sup> alternative methods to enable the introduction of aryl and trifluoromethyl groups across the double bond of alkenes by transition-metal-mediated or metal-free protocols have been independently developed. Although these strategies are effective, in most cases, these transformations proceed in an intramolecular fashion and some  $\beta$ -trifluoromethylated oxindoles derivatives with various biological activity are synthesized from *N*-aryl acrylamide substrates (Scheme 1a). In sharp contrast, the reports on the formation of the products in an acyclic manner through the cascade aryltrifluoromethylation of alkenes are relatively rare. Very recently, the Nevado group described respectively the copper- and tetrabutylammonium iodide-catalyzed aryltrifluoromethylation of conjugated tosyl amides via a one-pot trifluoromethylation/aryl migration/desulfonylation sequence by employing Togni's reagent

as the CF<sub>3</sub> source, and a series of linear  $\alpha$ -aryl- $\beta$ -trifluoromethyl amides bearing a quaternary stereocenter were well established (Scheme 1b).<sup>8</sup> Despite effectiveness of Nevado's methods, increasing the diversity of available methodologies that realize the successful formation of acyclic  $\alpha$ -aryl- $\beta$ -trifluoromethyl amides from activated alkenes is still of considerable interest.

Light-driven chemical transformations including photoredox catalysis are becoming one of the efficient and sustainable tools in synthetic chemistry.<sup>9</sup> Undoubtedly, searching for particularly useful catalysts that can promote the organic transformations effectively is a key in this field. Over the past decade various photocatalysts or sensitizers have been synthesized. In general, they can be mainly classified into three types: organic dyes, ruthenium(II) or iridium(III) or copper(I) metal complexes, and inorganic semiconductors. Among them, inorganic semiconductors have been recognized as the highly promising type due to their unique characteristics, such as easy-preparation, cheap, nontoxic, efficient, recyclable and so on. Usually, TiO<sub>2</sub>, ZnO, ZnS and CdS are typical semiconductors for organic chemical transformations because of their unique wide band gaps.<sup>10</sup> In recent years, inorganic bismuth-containing nanomaterials have been found to be the potential photocatalysts, which show strong absorption in UV or visible-light region.<sup>11</sup> Apart from their photocatalytic applications for the degradation of organic dyes and splitting of water into hydrogen and oxygen, the use of them for photocatalytic synthesis of organic molecules has also been reported. For example, Pericàs and König groups reported a light-driven asymmetric  $\alpha$ -alkylation of aldehydes by combining Bi<sub>2</sub>O<sub>3</sub> or PbBiO<sub>2</sub>Br as the low-band-gap photocatalyst with the MacMillan imidazolidinone as the chiral catalyst.<sup>12</sup> Later, the Pericàs group demonstrated that Bi<sub>2</sub>O<sub>3</sub> could be used as efficient photocatalysts for the atom transfer radical addition (ATRA) reaction of organobromides to diversely functionalized terminal olefins.<sup>13</sup> The Fu *et al.* made an advance on finding a surface-chlorinated BiOBr/TiO<sub>2</sub> hybrid composites to realize the selective C<sub>sp3</sub>-H bonds functionalization of alkanes.<sup>14</sup> The asymmetric reactions, difunctionalization of alkenes, and C-H bonds functionalizations are the current hot research topics in chemistry and materials science, revealing that the inorganic bismuth semiconductors are a kind of potential and alternative

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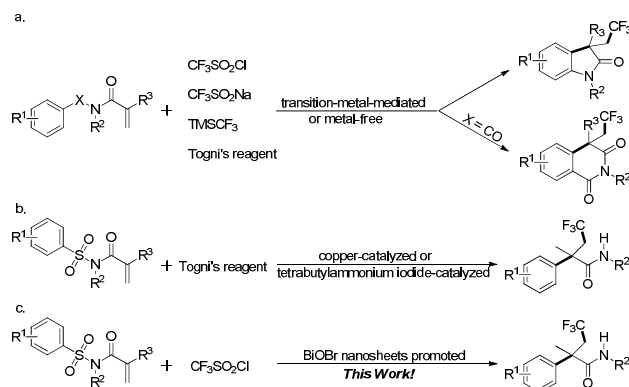
Electronic Supplementary Information (ESI) available: optimization of the reaction conditions, experimental procedures and full spectroscopic data for all compounds. See DOI: 10.1039/x0xx00000x

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photocatalysts for chemical transformations. Therefore, the development of bismuth-based photocatalysts for new organic reactions, particularly the tandem transformations, is highly desirable.

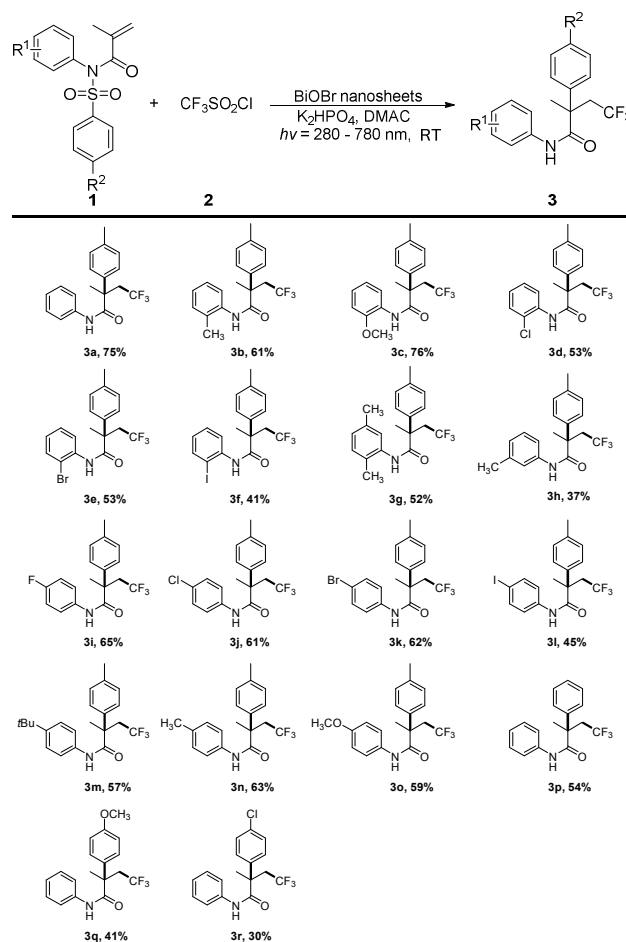
Herein, we present a light-mediated, BiOBr nanosheets promoted one-pot cascade trifluoromethylation/1,4-aryl migration/desulfonylation and N-H bond formation reaction of conjugated tosyl amides, and a series of  $\alpha$ -aryl- $\beta$ -trifluoromethyl amides with diverse functional groups are successfully prepared (Scheme 1c). These trifluoromethyl functionalized organic compounds maybe find potential applications in pharmaceuticals, agrochemicals, and functional materials.<sup>15</sup>



The as-prepared BiOBr is a layer-structured semiconductor.<sup>16</sup> Inorganic nanosheets are considered as one kind of efficient photocatalysts due to the dramatically improving intrinsic catalytic properties of nanosheets over other correspond inorganic counterparts.<sup>17</sup> The reductive potential of electrons in the conduction band of BiOBr semiconductor is  $-0.27$  V (vs. SCE),<sup>11a</sup> which is higher than  $\text{CF}_3\text{SO}_2\text{Cl}$  ( $-0.18$  V vs. SCE).<sup>18</sup> It means that the photogenerated electron of BiOBr can effectively reduce  $\text{CF}_3\text{SO}_2\text{Cl}$  and thus produce the  $\text{CF}_3$  radical, which be used for subsequent transformation of alkenes. Our group has recently reported the trifluoromethylation/arylation of *N*-aryl acrylamide using BiOBr nanosheets as photocatalysts.<sup>15</sup> We speculate that this photocatalytic method may also facilitate the trifluoromethylation/aryl migration/desulfonylation of the conjugated tosyl amide substrates. To validate the hypothesis, *N*-phenyl-*N*-tosylmethacrylamide **1a** and  $\text{CF}_3\text{SO}_2\text{Cl}$  **2** are selected as model substrates in conjunction with BiOBr nanosheets,  $\text{K}_2\text{HPO}_4$  and  $\text{HSiEt}_3$  in DMF under light excitation ( $280\sim 780$  nm) for 6 h. It is found that the one-pot sequential transformation of **1a** definitely occurs, and 74% yield of  $\alpha$ -aryl- $\beta$ -trifluoromethyl amide is obtained (Table S1, entry 1). When DMF is replaced with DMAC, the yield of the product is slightly increased (Table S1, entry 2). However, when the reaction is carried out in the absence of  $\text{HSiEt}_3$ , a comparable yield of **3a** is obtained (Table S1, entry 3). Although the reaction efficiency is a little improved due to the addition of  $\text{HSiEt}_3$ , in order to reduce the complexity of the operation, we determine that the  $\text{HSiEt}_3$  is not a necessary additive. Encouraged by this result, othe solvent are screened next. We observe that only DMAC gives the best result and the others are inferior or even noneffective. These

results suggest a significant solvent dependence for this photocatalytic reaction (Table S1, entries 4-10). Notably, no product **3a** is detected either in the dark or in the absence of BiOBr nanosheets, strongly illustrating that the light and the photoredox catalysts are important to induce this reaction (Table S1, entries 11, 12). We have attempted to use CdS nanosheets and  $\text{Ru}(\text{bpy})_3\text{Cl}_2\cdot 6\text{H}_2\text{O}$  as alternative photocatalysts, which are demonstrated exceptional photocatalytic properties for organic transformations, however, dissatisfactory results are obtained (Table S1, entries 13-14).

**Table 1** Substrate scope of the photocatalytic cascade reaction of alkenes<sup>a</sup>

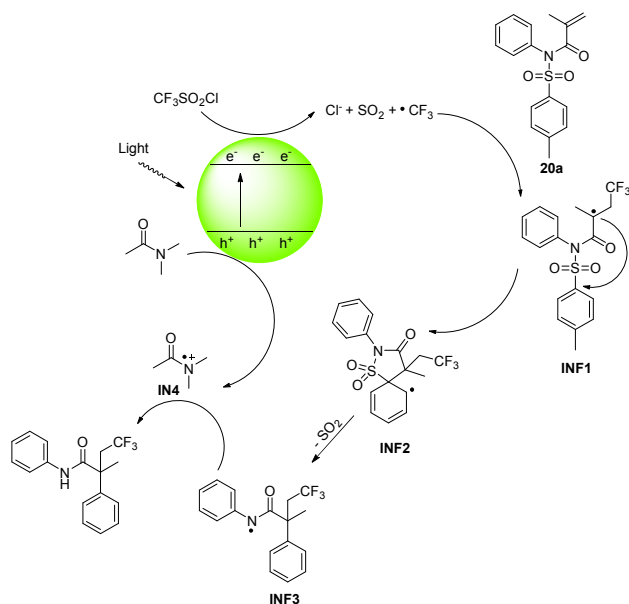
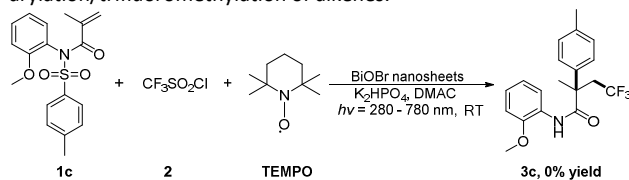


<sup>a</sup> Reaction conditions: **1a** (0.2 mmol), **2**  $\text{CF}_3\text{SO}_2\text{Cl}$  (1.0 mmol),  $\text{K}_2\text{HPO}_4$  (0.6 mmol), BiOBr nanosheets (20 mg), DMAC (1.0 mL), 300 W Xe arc lamp, RT.

Under the optimized reaction conditions, the scope of this transformation is explored and displayed in Table 1. We firstly examine the substitution pattern on the aromatic ring directly bound to the N atom. When the substituents at the *ortho* position, these one-pot sequential reactions can produce the corresponding aryltrifluoromethylated amides in moderate to good yields (Table 1, **3b-e**). The 1,4-dimethyl substituted tosyl amide does not hinder the reaction, and the product **3g** can be isolated in 52% yield. Substrate **1h** with a methyl on the *meta* position of phenyl ring is also amenable to the standard conditions, and 37% yield of the product

is obtained. The introduction of either electron-donating or electron-withdrawing groups at the *para* position is well tolerated, and 57% to 65% yields of the  $\beta$ -trifluoromethylated amides are constructed (Table 1, **3i-k**, **3m-o**). In contrast, the presence of iodoine seems to decrease the reaction efficiency no matter where the iodine atom lies on the aryl ring (Table 1, **3f** and **3l**). Next, the influence of the substituents on the aromatic ring of the sulfonamide group is also investigated. Replacement of the methyl group by either a hydrogen, methoxyl, or chlorine giving rise to the corresponding products in slightly lower yields (Table 1, **3p-r**). All the obtained results indicate that our photocatalytic methodology is particularly universal, and may provide a new facile access to the synthesis of  $\text{CF}_3$ -containing pharmaceutical blocks.

In order to verify whether these reactions proceed through a radical pathway, the control experiments are performed (Scheme 2). Treatment of **1c** with **2** under standard conditions with the addition of radical trapping agent 2,2,6,6-tetramethylpiperidine-1-oxyl (TEMPO) delivers no desirable product, further supports that a radical process is involved in our photocatalytic arylation/trifluoromethylation of alkenes.



Based on the above results and related photocatalytic literatures,<sup>6-8,10b</sup> a plausible reaction mechanism is proposed in Scheme 3. Light absorption of BiOBr nanosheets promotes the electron transfer from the valence band (VB) to the conduction band (CB), which is a key photochemical step.  $\text{CF}_3\text{SO}_2\text{Cl}$  is then reduced by the photogenerated electron to generate the corresponding free radical anion of triflyl chloride, which experiences fast collapses to form the relative stable  $\text{CF}_3$  radical with sulfur dioxide and chloride

anion.<sup>18</sup> Subsequently, the  $\text{CF}_3$  radical interacts with alkene **1a** affording the activated radical intermediate **IN1**. A dearomatization/5-ipso cyclization then takes place on the aromatic ring generating aryl radical **IN2**. Rearomatization of **IN2** with concomitant desulfonation leads to amidyl radical **IN3**. The photogenerated hole obtains an electron from the solvent DMAC via a single-electron transfer process to close the catalytic cycle and meanwhile give the radical cation **IN4**. The amide functions as an efficient electron donor could be found in many reactions.<sup>19</sup> Finally, the formed intermediate **IN3** abstracts the hydrogen radical released from **IN4** to deliver the desired product **3a**. The preliminary mechanism may need further theoretical understanding.

## Conclusions

In conclusion, we have developed a facile light-induced, BiOBr nanosheets promoted one-pot tandem trifluoromethylation/1,4-aryl migration/desulfonation and N-H bond formation reaction of conjugated *N*-tosyl amides. This strategy enables a practical access to a series of  $\alpha$ -aryl- $\beta$ -trifluoromethyl amides bearing a quaternary stereocenter in moderate to good yields. In this heterogeneous reaction media, electron-exchange occurs between the organic intermediates in solution and the semiconductor surface. Control experiments illustrate that the synergistic effect of photogenerated electrons and holes plays a key role for the reaction efficiency. This low-cost, green and efficient photocatalytic strategy can be considered as a viable alternative to the previously mentioned methods. Further explorations on light-mediated cascade reactions and mechanistic understanding are currently being investigating in our laboratory.

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## Notes and references

- (a) J. Zhou, *Chem. Asian J.*, 2010, **5**, 422; (b) L. Chen, Y. Du, X.-P. Zeng, T.-D. Shi, F. Zhou and J. Zhou, *Org. Lett.*, 2015, **17**, 1557; (c) J.-C. Wasilke, S. J. Obrey, R. T. Baker and G. C. Bazan, *Chem. Rev.*, 2005, **105**, 1001; (d) K. C. Nicolaou, D. J. Edmonds and P. G. Bulger, *Angew. Chem. Int. Ed.*, 2006, **45**, 7134; (f) M. J. Gaunt, C. C. C. Johansson, A. McNally and N. T. Vo, *Drug Discovery Today*, 2007, **12**, 8; (g) Y. Xia, Y. Zhang and J. B. Wang, *ACS Catal.*, 2013, **3**, 2586.
- (a) C.-J. Wallentin, J. D. Nguyen, P. Finkbeiner and C. R. J. Stephenson, *J. Am. Chem. Soc.*, 2012, **134**, 8875; (b) J. Ignatowska and W. Dmowski, *J. Fluorine Chem.*, 2007, **128**, 997; (c) D. B. Bagal, G. Kachkovskiy, M. Knorn, T. Rawner, B. M. Bhanage, and O. Reiser, *Angew. Chem., Int. Ed.*, 2015, DOI: 10.1002/anie.201501880.
- (a) D. J. Wilger, N. J. Gesmundo and D. A. Nicewicz, *Chem. Sci.*, 2013, **4**, 3160; (b) X. Wu, L. L. Chu and F.-L. Qing, *Angew. Chem., Int. Ed.*, 2013, **52**, 2198; (c) Y. Yasu, T. Koike and M. Akita, *Org. Lett.*, 2013, **15**, 2136; (d) S. Mizuta, S. Verhoog, K. M. Engle, T. Khotavivattana, M. O. Duill, K. Wheelhouse, G. Rassias, M. Médebielle and V. Gouverneur, *J. Am. Chem. Soc.*, 2013, **135**, 2505.

- 4 (a) H. Egami, S. Kawamura, A. Miyazaki and M. Sodeoka, *Angew. Chem., Int. Ed.*, 2013, **52**, 7841; (b) F. Wang, X. X. Qi, Z. L. Liang, P. H. Chen and G. S. Liu, *Angew. Chem., Int. Ed.*, 2014, **53**, 1881; (c) S. Kawamura, H. Egami and M. Sodeoka, *J. Am. Chem. Soc.*, 2015, **137**, 4865; (d) Y. Yasu, T. Koike and M. Akita, *Org. Lett.*, 2013, **15**, 2136; (e) A. Carboni, G. Dagousset, E. Magnier and G. Masson, *Org. Lett.*, 2014, **16**, 1240.
- 5 (a) Y. Yasu, T. Koike and M. Akita, *Angew. Chem., Int. Ed.*, 2012, **51**, 9567; (b) R. Tomita, Y. Yasu, T. Koike and M. Akita, *Angew. Chem., Int. Ed.*, 2014, **53**, 7144; (c) H. Egami, R. Shimizu and M. Sodeoka, *Tetrahedron Lett.*, 2012, **53**, 5503; (d) R. Zhu and S. L. Buchwald, *J. Am. Chem. Soc.*, 2012, **134**, 12462; (e) P. G. Janson, I. Ghoneim, N. O. Ichenko and K. J. Szabó, *Org. Lett.*, 2012, **14**, 2882; (f) Y. Li and A. Studer, *Angew. Chem., Int. Ed.*, 2012, **51**, 8221; (g) C. Feng and T.-P. Loh, *Chem. Sci.*, 2012, **3**, 3458.
- 6 (a) E. Merino and C. Nevado, *Chem. Soc. Rev.*, 2014, **43**, 6598; (b) L. L. Shi, X. B. Yang, Y. Y. Wang, H. J. Yang and H. Fu, *Adv. Synth. Catal.*, 2014, **356**, 1021; (c) W. J. Fu, F. J. Xu, Y. Q. Fu, C. Xu, S. H. Li and D. P. Zou, *Eur. J. Org. Chem.*, 2014, 709; (d) L. Li, M. Deng, S.-C. Zheng, Y.-P. Xiong, B. Tan and X.-Y. Liu, *Org. Lett.*, 2014, **16**, 504; (e) F. Yang, P. Klumphu, Y.-M. Liang and B. H. Lipshutz, *Chem. Commun.*, 2014, **50**, 936; (f) W. Wei, J. W. Wen and H. Wang, *J. Org. Chem.*, 2014, **79**, 4225; (g) X.-J. Tang, C. S. Thomason and W. R. Dolbier, *Org. Lett.*, 2014, **16**, 4594; (h) H. Egami, R. Shimizu and M. Sodeoka, *J. Fluorine Chem.*, 2013, **152**, 51; (i) P. Xu, J. Xie, Q. C. Xue, C. D. Pan, Y. X. Cheng and C. J. Zhu, *Chem. Eur. J.*, 2013, **19**, 14039; (j) S. Tang, Z. H. Li, M. W. Wang, Z. P. Li and R. L. Sheng, *Org. Biomol. Chem.*, 2015, **13**, 5285; (k) H. Egami, R. Shimizu, S. Kawamura and M. Sodeoka, *Angew. Chem., Int. Ed.*, 2013, **52**, 4000; (l) F. Wang, D. H. Wang, X. Mu, P. H. Chen and G. S. Liu, *J. Am. Chem. Soc.*, 2014, **136**, 10202; (m) X. W. Liu, F. Xiong, X. P. Huang, L. Xu, P. F. Li and X. X. Wu, *Angew. Chem., Int. Ed.*, 2013, **52**, 6962.
- 7 X. Mu, T. Wu, H. Y. Wang, Y. L. Guo and G. S. Liu, *J. Am. Chem. Soc.*, 2012, **134**, 878.
- 8 (a) W. Q. Kong, M. Casimiro, E. B. Merino and C. Nevado, *J. Am. Chem. Soc.*, 2013, **135**, 14480; (b) W. Q. Kong, M. Casimiro, N. Fuentes, E. Merino and C. Nevado, *Angew. Chem. Int. Ed.*, 2013, **52**, 13086.
- 9 Selected examples see: (a) Q.-Y. Meng, J.-J. Zhong, Q. Liu, X.-W. Gao, H.-H. Zhang, T. Lei, Z.-J. Li, K. Feng, B. Chen, C.-H. Tung and L.-Z. Wu, *J. Am. Chem. Soc.*, 2013, **135**, 19052; (b) J. M. R. Narayanam and C. R. J. Stephenson, *Chem. Soc. Rev.*, 2011, **40**, 102; (c) N. Iqbal, J. Jung, S. Park and E. J. Cho, *Angew. Chem., Int. Ed.*, 2014, **53**, 539; (d) J. Xie, Q. C. Xue, H. M. Jin, H. M. Li, Y. X. Cheng and C. J. Zhu, *Chem. Sci.*, 2013, **4**, 1281; (e) M. Fagnoni, D. Dondi, D. Ravelli and A. Albini, *Chem. Rev.*, 2007, **107**, 2725; (f) J. Xuan and W. J. Xiao, *Angew. Chem., Int. Ed.*, 2012, **51**, 6828; (g) S. Q. Zhu, A. Das, L. Bui, H. J. Zhou, D. P. Curran and M. Rueping, *J. Am. Chem. Soc.*, 2013, **135**, 1823; (h) H. Jiang, Y. Z. Cheng, R. Z. Wang, M. M. Zheng, Y. Zhang and S. Y. Yu, *Angew. Chem., Int. Ed.*, 2013, **52**, 13289; (i) C. K. Prier, D. A. Rankic and D. W. C. MacMillan, *Chem. Rev.*, 2013, **113**, 5322; (j) L. J. Allen, P. J. Cabrera, M. Lee and M. S. Sanford, *J. Am. Chem. Soc.*, 2014, **136**, 5607; (k) S. Fukuzumi and K. Ohkubo, *Chem. Sci.*, 2013, **4**, 561; (l) F. Z. Su, S. C. Mathew, L. Möhlmann, M. Antonietti, X. C. Wang and S. Blechert, *Angew. Chem., Int. Ed.*, 2011, **50**, 657.
- 10 Selected examples see: (a) X. J. Lang, X. D. Chen and J. C. Zhao, *Chem. Soc. Rev.*, 2014, **43**, 473; (b) M. Cherevatskaya and B. König, *Russ. Chem. Rev.*, 2014, **83**, 183; (c) M. Rueping, J. Zoller, D. C. Fabry, K. Poschorny, R. M. Koenigs, T. E. Weirich and J. Mayer, *Chem. Eur. J.*, 2012, **18**, 3478; (d) T. Caronna, C. Gambarotti, L. Palmisano, C. Punta and F. Recupero, *Chem. Commun.*, 2003, 2350; (e) A. Villa, G. M. Veith, D. Ferri, A. Weidenkaff, K. A. Perry, S. Campisia and L. Prati, *Catal. Sci. Technol.*, 2013, 394; (f) H. Kisch, *Adv. Photochem.*, 2001, **26**, 93; (g) T. Mitkina, C. Stanglmair, W. Setzer, M. Gruber, H. Kisch and B. König, *Org. Biomol. Chem.*, 2012, **10**, 3556; (h) W. W. Zhao, C. B. Liu, L. M. Cao, X. G. Yin, H. L. Xu and B. Zhang, *RSC Adv.*, 2013, **3**, 22944.
- 11 (a) Z. Jiang, F. Yang, G. D. Yang, L. Kong, M. O. Jones, T. C. Xiao and P. P. Edwards, *J. Photochem. Photobiol. A*, 2010, **212**, 8; (b) Z. K. Xu, L. Han, B. H. Lou, X. W. Zhang and S. J. Dong, *Nanoscale*, 2014, **6**, 145; (c) H. J. Zhang, Y. X. Yang, Z. Zhou, Y. P. Zhao and L. Liu, *J. Phys. Chem. C*, 2014, **118**, 14662.
- 12 (a) P. Riente, A. M. Adams, J. Albero, E. Palomares and M. A. Pericàs, *Angew. Chem., Int. Ed.*, 2014, **53**, 9613; (b) M. Cherevatskaya, M. Neumann, S. Földner, C. Harlander, S. Kümmel, S. Dankesreiter, A. Pfitzner, K. Zeitler and B. König, *Angew. Chem., Int. Ed.*, 2012, **51**, 4062.
- 13 P. Riente and M. A. Pericàs, *ChemSusChem* 2015, DOI: 10.1002/cssc.201403466.
- 14 R. S. Yuan, S. L. Fan, H. X. Zhou, Z. X. Ding, S. Lin, Z. H. Li, Z. Z. Zhang, C. Xu, L. Wu, X. X. Wang and X. Z. Fu, *Angew. Chem., Int. Ed.*, 2013, **52**, 1035.
- 15 Selected examples see: (a) K. Müller, C. Faeh and F. Diederich, *Science*, 2007, **317**, 1881; (b) T. Furuya, A. S. Kamlet and T. Ritter, *Nature*, 2010, **473**, 470; (c) X.-H. Xu, K. Matsuzaki and N. Shibata, *Chem. Rev.*, 2015, **115**, 731; (d) J. Nie, H. C. Guo, D. Cahard and J.-A. Ma, *Chem. Rev.*, 2011, **111**, 455; (e) O. Tomashenko and V. V. Grushin, *Chem. Rev.*, 2011, **111**, 4475; (f) S. Purser, P. R. Moore, S. Swallow and V. Gouverneur, *Chem. Soc. Rev.*, 2008, **37**, 320; (g) V. Matoušek, A. Togni, V. Bizet and D. Cahard, *Org. Lett.*, 2011, **13**, 5762.
- 16 C. B. Liu, W. W. Zhao, Y. Huang, H. M. Wang and B. Zhang, *Tetrahedron*, 2015, **71**, 4344.
- 17 (a) M. L. Guan, C. Xiao, J. Zhang, S. J. Fan, R. An, Q. M. Cheng, J. F. Xie, M. Zhou, B. J. Ye and Y. Xie, *J. Am. Chem. Soc.*, 2013, **135**, 10411; (b) Y. Xu, W. W. Zhao, R. Xu, Y. M. Shi and B. Zhang, *Chem. Commun.*, 2013, **49**, 9803; (c) L. C. Liu, Z. Y. Ji, W. X. Zou, X. R. Gu, Y. Deng, F. Gao, C. J. Tang and L. Dong, *ACS Catal.*, 2013, **3**, 2052.
- 18 D. A. Nagib and D. W. C. MacMillan, *Nature*, 2011, **480**, 224.
- 19 (a) Z. C. Zhang, Y. F. Chen, X. B. Xu, J. C. Zhang, G. L. Xiang, W. He and X. Wang, *Angew. Chem.*, 2014, **126**, 439; (b) L. C. He, Y. Liu, J. Z. Liu, Y. S. Xiong, J. Z. Zheng, Y. L. Liu and Z. Y. Tang, *Angew. Chem. Int. Ed.*, 2013, **52**, 3741; (c) Y. L. Hu, J. Liao, D. M. Wang and G. K. Li, *Anal. Chem.*, 2014, **86**, 3955.



## Graphic Abstract

# Light-Mediated Cascade Transformation of Activated Alkenes: BiOBr Nanosheets as Efficient Photocatalysts for the Synthesis of $\alpha$ -aryl- $\beta$ -trifluoromethyl Amides

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A facile light induced, BiOBr nanosheets promoted one-pot consecutive trifluoromethylation/aryl migration/desulfonylation and N-H bond formation of activated alkenes is proposed.

