Dearomatizative Spirocyclization-Functionalization by Activation of Alkyne Side Chain Using Chiral Hypervalent Iodine Reagent

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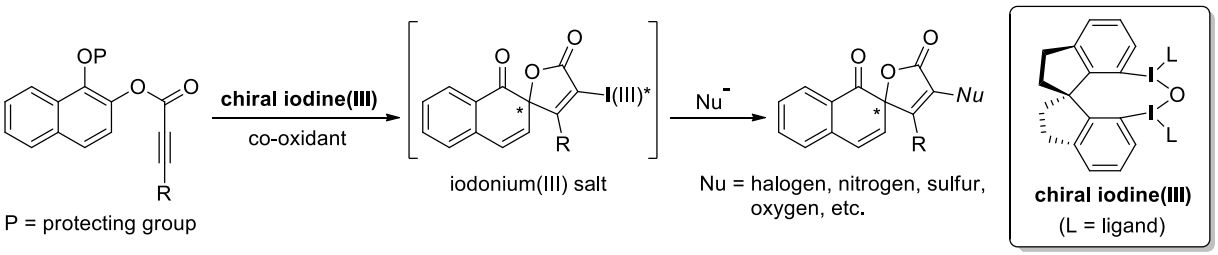
Spirocyclic structure is one of the unique backbones in organic compounds. Because of the unique spirocyclic structure, these compounds show interesting biological activities having been investigated in the field of pharmaceutical and agrichemical sciences. Our research group previously reported the oxidations of *para*-substituted phenol derivatives to construct spirodienone structure using hypervalent iodine(III) reagents, such as $PhI(OAc)_2$ (PIDA) and $PhI(OCOCF_3)_2$ (PIFA).[1)] In addition, we have recently achieved the catalytic asymmetric *ortho*-spirolactonization utilizing designer chiral hypervalent iodine(III) reagents.[2)]

Herein, we have developed asymmetric dearomatizative spirocyclization-functionalization[3)] based on the activation of alkyne side-chain utilizing the chiral hypervalent iodine(III) reagents. Similar spirocyclizations involving activation of alkyne moieties induced by electrophiles, such as I_2 and ICl, were reported,[4)] but aysmmetric construction of the spirocylic structures with introduction of various functional groups is difficult in these methods. Considering such backgrounds, we have examined an asymmetric synthesis of functionalized spirocycles *via* iodonium(III) salts using our chiral hypervalent iodine(III) species (Scheme 1). As a result, various functionalized spirocyclic compounds with asymmetric inductions at the spiro carbon center can be obtained in good yields after replacement of the iodonium(III) groups by halogen, oxygen, nitrogen, and sulfur nucleophiles.



Scheme 1

1) Y. Kita *et al*. *J. Org. Chem.* **1987**, *52*, 3927; *J. Am. Chem. Soc.* **1992**, *114*, 2175. 2) T. Dohi, Y. Kita *et al*. *Angew. Chem. Int. Ed.* **2008**, *47*, 3787; *J. Am. Chem. Soc.* **2013**, *135*, 4558; *J. Org. Chem.* **2017**, *82*, 11954. 3) Racemic synthesis: T. Dohi, Y. Kita *et al*. *Angew. Chem. Int. Ed.* **2011**, *50*, 3784; *Org. Biomol. Chem.* **2011**, *9*, 6899. 4) (a) E. Fanghänel *et al*. *Eur. J. Org. Chem.* **2003**, 47. (b) C. Larock *et al*. *J. Am. Chem. Soc.* **2005**, *127*, 12230. (c) Y. Chen *et al*. *Chem.-Eur. J.* **2013**, *19*, 9795 and references therein.