Imidazoline-amino acid/Copper-Catalyzed Asymmetric *exo*-Selective [3+2] Cycloaddition of Iminoesters with Nitroalkenes

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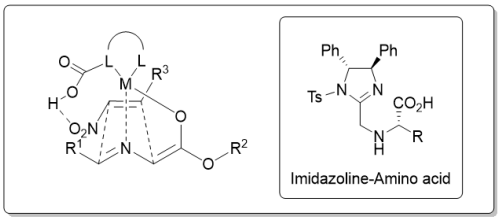
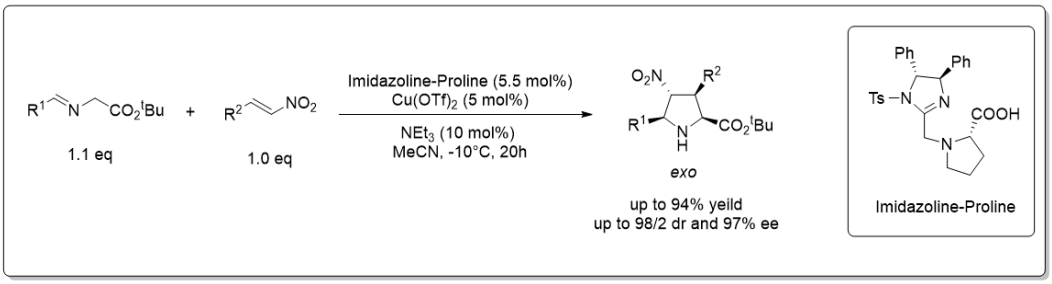
1,3-dipolar cyclization reaction has been a powerful method for the synthesis of multisubstituted pyrrolidines. Cycloaddition of iminoester and nitroalkene has the ability to introduce a nitro functionality onto the pyrrolidine. So far, our laboratory has developed novel catalytic systems of imidazoline amino phenol ligand (IAP)-Ni(II) and bis(imidazoline)pyridine ligand (PyBidine)-Cu(II), and respectively achieved asymmetric synthesis of *exo'* and *endo*- nitro functional pyrrolidines.[1)]



In this work, we designed a new catalyst for accessing the *exo*-selective cycloaddition, in which a hydrogen bonding interaction between ligand with nitro group is investigated. Among a series of imidazoline-amino acid ligands-metal complexes we synthesized, diphenylethylenediamine-derived imidazoline-proline (IP) ligand-Cu catalyst showed good catalytic activity in the 1,3-dipolar cyclization reaction of *tert*-Butyl iminoesters with nitroalkenes to give the products with high *exo*-selectivity.



Analysis on intermediate of this reaction suggests a stepwise Michael-Mannich mechanism. Further experiments implied the irreplaceable role of nitro group from nitroalkenes and proton from IP ligand.

(1) a) Arai, T.; Yokoyama, N.; Mishiro, A.; Sato, H. *Angew. Chem. Int. Ed.* **2010**, *49*, 7895-7898; b) Arai, T.; Mishiro, N.; Yokoyama, K. Suzuki, H.; Sato, H. *J. Am. Chem. Soc*. **2010**, *132*, 5338.