Iron-Catalyzed Cross Coupling of Organoboron Reagents with Propargyl Electrophiles

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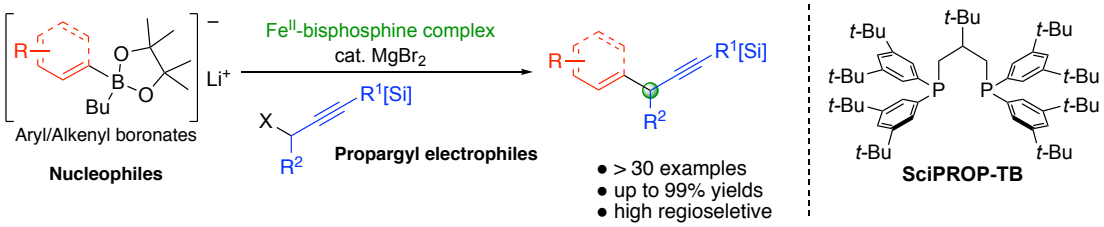
Cross-coupling reactions of propargyl electrophiles with various nucleophiles have been extensively investigated over the last few decades because of their synthetic potential to access various alkynes and allenes, the fundamental functional groups in organic chemistry. Early researchers focused on second and third-row transition metals, such as rhodium and palladium, to catalyze the cross-coupling reactions to produce allene products in a highly regioselective manner.[1] On the other hand, catalytic reactions using first-row transition metals, such as nickel and iron, have been proved a new strategy to afford alkyne products with the opposite regioselectivity.[2] Recently, we reported an iron-catalyzed cross-coupling reaction of primary propargyl halides under ligand-free conditions. Secondary substrates resulted in low yield.[2b] Herein, we present the ligand-controlled iron-catalyzed regioselective cross coupling of a broader range of propargyl electrophiles with organoboron reagents.

The organoboron reagents activated by BuLi cross-coupled with propargyl electrophiles smoothly in the presence of a catalytic amount of iron-bisphosphine complex and $MgBr_2$ (Scheme 1). The combination of a bulky bisphosphine ligand SciPROP-TB and $FeCl_2$ was found to show a high catalytic activity by screening ligands and iron pre-catalysts, providing the final alkyne compounds regioselectively in good to excellent yields. This reaction shows excellent functional and heterocycle group tolerance, exhibiting a broad scope of substrates, including more than 30 examples. This presentation will report the scope of organoboron reagents and secondary propargyl electrophiles. In addition, the mechanistic investigation, which shows the intermediacy of propargyl radicals, will be discussed.

Scheme 1



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