Cross-Coupling Reactions of Organoboranes: An Easy Way for Carbon-Carbon Bonding

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The palladium-catalyzed cross-coupling reaction between different types of organoboron compounds and various organic halides or triflates in the presence of base provides a powerful and general methodology for the formation of carbon-carbon bonds. The (sp$^3$)C-B compounds (alkylboron compounds) and (sp$^2$)C-B compounds (such as aryl- and 1-alkenylboron derivatives) readily cross-couple with organic electrophiles to give coupled products selectively in high yields. Recently, the (sp)C-B compounds (1-alkynylboron derivatives) have been also observed to react with organic electrophiles to produce expected cross-coupled products.

Such coupling reactions offer several advantages:

1. Ready availability of reactants
2. Mild reaction conditions
3. Water stability
4. Easy use of the reaction both in aqueous and heterogeneous conditions
5. Tolerance of a broad range of functional groups
6. High regio- and stereoselectivity of the reaction
7. Insignificant effect of steric hindrance
8. Use of a small amount of catalysts
9. Application in one-pot synthesis
10. Nontoxic reaction
11. Easy separation of inorganic boron compound
12. Green chemistry

As one of defects of the reaction, one would point out the use of bases. However, we could overcome the difficulty by using suitable solvent systems and adequate bases. Consequently, these coupling reactions have been actively utilized not only in academic laboratories but also in industrial processes.

In this lecture, the overview of the coupling reaction will be discussed to understand the whole.