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A Novel Mechanistic Paradigm for Cross-Coupling

Research interests encompass the development of new synthetic methods and their application to the synthesis of organic molecules. The group's focus is to expand and improve the Suzuki coupling reaction for organoboron compounds. Robust, air- and water-stable potassium organotrifluoroborates (R-BF₃K), are employed to carry out couplings under relatively mild conditions using non-toxic components.

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Abstract

Organoboron compounds have revolutionized the pharma, agrochemical, and other industries by providing facile access to structural systems that were previously difficult to synthesize efficiently. Boronic acids and boronate esters have typically been the focus of much of these research efforts, and until recently little effort has been expended toward further development of other, perhaps complementary or advantageous, organoboron reagents. Boronic acids, commonly used for Suzuki-Miyaura coupling, are far from ideal. Because of competitive protodeboronation, literature protocols for cross-coupling employ excess boronic acid to insure a complete conversion of the electrophilic component of the reaction. Additionally, alkyl cross-coupling utilizing standard protocols suffer from competitive processes such as β -hydride elimination, forming a variety of byproducts. General approaches to enantioselective cross-coupling have also proved challenging.

Alternatives to boronic acids and their derivatives will be discussed, with an emphasis on the synthesis and use of the more robust organotrifluoroborate reagents. A novel approach to cross-coupling will be revealed that provides a complementary approach to this important transformation. The protocol establishes a unique paradigm for cross-coupling that involves a dual catalytic cycle, one of which relies upon photoredox catalysis.

Host: Professor Thomas Hoye