

University of Louisville
Department of Chemistry

Deborah Ogulu Literature Seminar

When: October 15, 2020

Time: 2:30 PM

Location: Microsoft TEAMS

Transition Metal-Catalyzed Carbon-Heteroatom Bond Forming Reactions

Abstract

Reactions catalyzed by transition metals (TM) have become the preferred approach for synthesizing new chemical entities, as evidenced by the 2010 Noble prize and the 2019 Wolf prize in chemistry. These extremely useful transformations involve TM-mediated couplings of electrophilic aryl halides with an organometallic or organic nucleophile.¹ Some of the significant advantages of these processes include mild reaction conditions, high functional group tolerance, better reactivity, excellent selectivity, total cost reduction, minimal side products, etc.² All these features of catalytic cross-couplings have led to several industrial applications including, synthesis of active pharmaceutical ingredients (APIs), natural products, agrochemicals, medicinal and materials chemistry, etc. Undoubtedly, the backbone of most organic compounds is composed of C–C bonds, but the function of these compounds is often derived from the presence of heteroatoms, such as nitrogen, oxygen, and sulfur held by C–X (X = N, O, S) bonds.³ In this seminar, we will discuss various catalytic methods for the formation of challenging C–X bonds.

The C–X bond-forming reactions are an essential class of reactions due to the widespread distribution of nitrogen, oxygen, and sulfur heterocycles in naturally occurring and medicinally relevant compounds.⁴ Among established methods to access useful C–N bonds, the Buchwald-Hartwig amination of aryl halides have become an efficient process for preparing various functionalized amines. Using earth-abundant ligated Nickel as a pre-catalyst and a soluble organic base, Buchwald and co-workers developed an efficient method for the homogeneous coupling of phenol derivatives with anilines to form new C–N bonds.⁵ This development has subsequently enabled both C–O and C–S bond-forming reactions. The Buchwald group further improved the process for palladium-catalyzed C–O couplings by using a biaryl phosphine ligand to connect challenging secondary alcohols with (hetero)aryl halides.⁶ This approach was further fine-tuned for the construction of challenging C–S bonds using monophosphine ligands under mild conditions.⁷ In conclusion, the establishment of these C–X bond-forming reactions serves as the foundation for further exploration into carbon–heteroatom cross-couplings sustainably. Given the amount of high-yielding processes and robust applications of these cross-couplings, many advancements are expected over the coming years, especially in the aspect of greenness and sustainability.

References

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