Oxidation-Induced C-H Functionalization and Updating Oxidative Cross-Coupling

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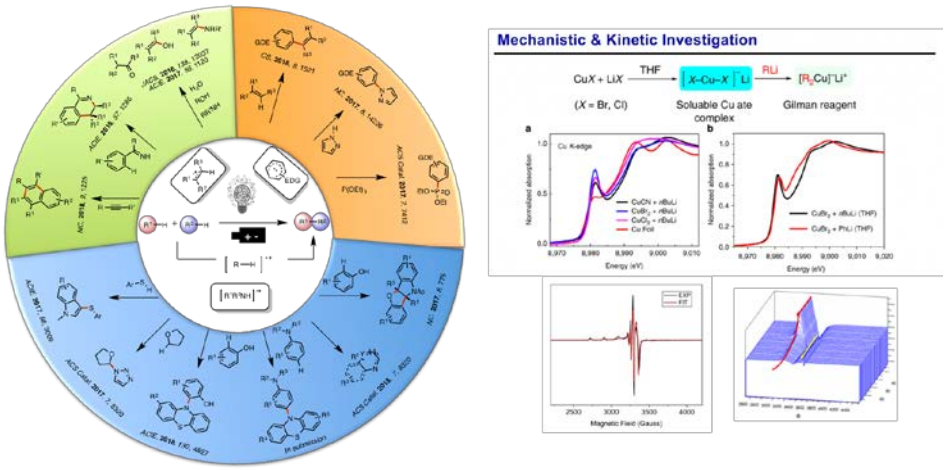
New chemical bond creation is of great importance in organic synthesis since many chemical bonds such as C-N, C-S, C-O and C-C bonds, exist in many natural products, pharmaceuticals, and fundamental materials. Therefore, we devoted a new bond forming strategy: "Oxidative Cross-coupling", that is, by utilizing two nucleophiles Nu1/Nu2 as substrates to perform the above strategy instead of the traditional coupling reactions between electrophile and nucleophile. Thus, to achieve the Green Chemistry in organic synthesis, we have developed four generations of oxidative coupling reactions. Recently, we established the direct cross-coupling reactions of two different R-Hs under oxidative conditions that can completely avoid the usage of stoichiometric organometallic reagents as the nucleophiles. In addition, we have developed series of small molecule activation based on novel catalytic materials, to explore and develop fundamental chemical principles for nano-catalysis. Three strategies of novel catalytic materials were approached in our laboratory: ultra-dispersed nanoparticles on various support, effect of dopant on nanocatalyst, and novel electrocatalysts for C-H activation. Furthermore, we are dedicating to discover and develop the organic oxidative cross-coupling reaction recently by introducing the in-situ generated nano-catalysts, single-site nano-catalysts and single-atom catalysts. So as to investigate the key intermediates in the oxidative coupling reactions, we designed a sample compartment of XAS and in situ IR spectroscopy to directly obtain structure information of organometallic complexes under real (catalytic) reactive conditions. Additionally, these catalytic reactions have been revealed by the *operando* X-ray absorption, SAXS, SEM, TEM, EPR, and NMR spectroscopy.



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Professional Career
Postdoctoral Fellow, Pennsylvania State University (2000-2003)
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Field of research
Organic Chemistry
1) Developing highly selective and efficient transition-metal-catalyzed C-C, and C-heteroatom bond formation in syntheses, e.g. oxidative coupling reactions, C-H bond functionalization
2) Mechanistic studies including kinetic and active intermediate studies