

Research Statement

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Molecules can clump together in harmony and perfect synchronization to generate a diverse variety of life forms the slightest change in their structure. This molecular play has always enticed me and deepened my interest in the field of chemical sciences. Harnessing the innate potential of organic small molecules to interact with the macromolecular life forms to relieve from pain and suffering, creating a positive change is the need of the hour. The current pandemic has reinforced this need and the expectation from chemists to deliver solutions for the current global challenges. I am passionate about designing synthetic strategies and their implementation into tangible working models. The joy of creative independence, the thrill of experimentation, and the challenge in pursuing a research career in synthetic organic chemistry are what I look forward to in the future. I am motivated to take up the global challenge of developing new methodologies to construct complex molecular skeletons that are relevant to naturally occurring and synthetic bioactive molecules employing earth-abundant metals as catalysts.

Over the recent years, earth-abundant transition metals like Fe, Cu, Ni, and Co have revolutionized catalysis. They are presently competing for their expensive congeners for the generation of more sustainable pathways. Unique redox activity makes them indispensable in devising multi-functionalization strategies to gain facile access to formidable skeletal motifs in a non-hazardous and efficient manner. Organometallics, the bridge between the organic and the inorganic, has transitional potential and extends its applicability to natural product synthesis, agrochemicals, pharmaceuticals, and material chemistry. Transitional metal complexes have proven their versatility in catalyzing chemical transformations such as coupling reactions, C-H activation, photoredox catalysis, and annulation reactions in a laboratory set-up and on an industrial scale. Coalescing the stereochemical identity via asymmetric synthesis using chiral ligand-bound metal complexes can further provide high-value optically enriched products or intermediates.

On the other hand, extensive research on popular reactive intermediates like carbocations, carbanions, and radicals has overshadowed the highly potent aryne intermediates. Arynes are transient yet highly reactive. As an attractive complementary approach to the classical C-H bond functionalization, arynes can furnish 1, 2-functionalized arenes or heteroarenes in the presence of suitable electrophilic and nucleophilic sources. Transition metal-catalyzed cascade reactions, spirocyclizations, annulations are also possible with the aryne system and can lead to the synthesis of exciting scaffolds. Inspired by such seminal works in literature, I wish to extend the successful catalyzed aryne chemistry to showcase excellent stereo-, chemo- and regioselectivity in complex molecular structures.

The challenges in designing a new experiment, critically analyzing the results, and drawing logical conclusions motivate me every day in the laboratory. I wish to undergo rigorous training while conducting my research aimed at overcoming present hurdles in synthetic methodologies. I believe the acquired skill set and international experience will prepare me for upcoming challenges that I face during my research career and in life. I think my sincerity, perseverance, and ability to work hard in a multi-cultural environment makes me a strong contender for this prestigious program. If selected for the same, it would instill confidence and inspire me further towards my research career goals. I would consider myself privileged and strive to excel in the international stage with utmost dedication and sincerity.