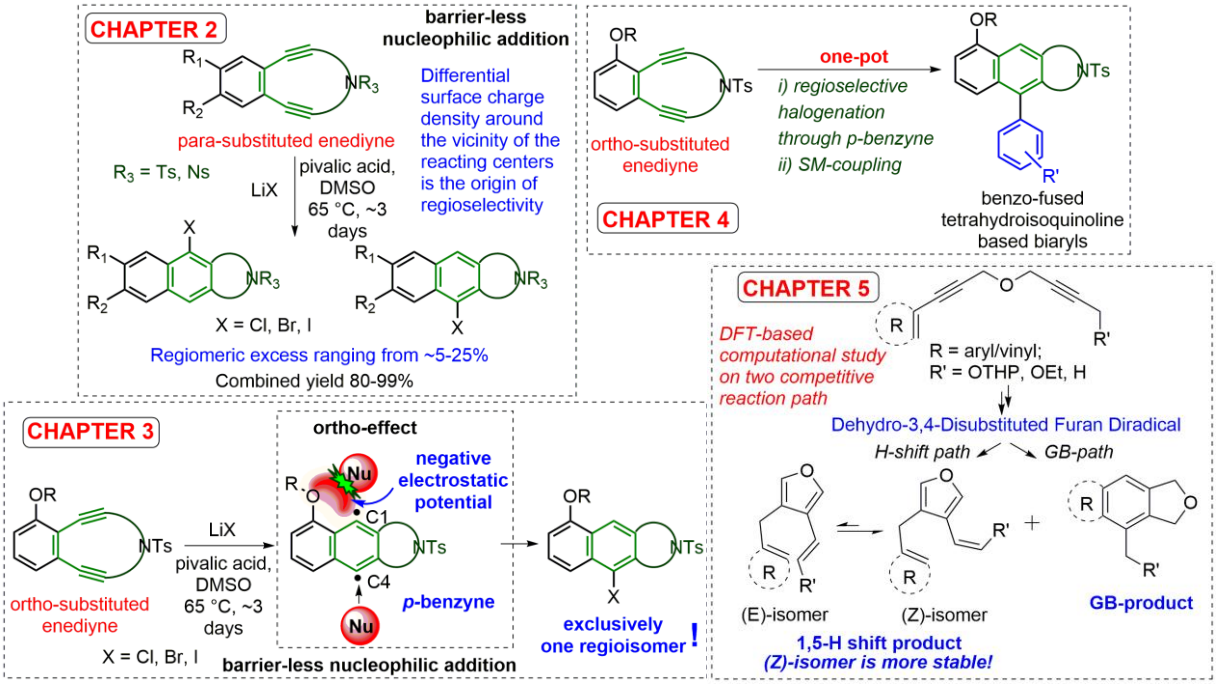
Abstract

Exploring the Mechanistic and Synthetic Aspects of Bergman and Garratt-Braverman Intermediates, the *p*-Benzyne and Dehydro-3,4-Disubstituted Furan Diradical

The cycloaromatization reactions generate a reactive diradical species from a closed-shell neutral molecule without the influence of any chemical initiator. Although extensive work has been reported on identifying the real character of the "so called diradical intermediate", controversy still persists on the vexed question of "diradical-ionic duality", especially for the *p*-benzynes in case of Bergman cyclization (BC). For Garratt-Braverman cyclization (GBC), the mechanism has similar dichotomy and is more complex with competing pathways. The work described in this thesis has addressed some of these issues with an aim to understand the reactivity of these intermediates and exploit these for synthesis. The thesis comprises five chapters with **Chapter 1** providing a concise review on BC and GBC, their mechanistic aspects including involvement of diradical and/or ionic intermediate. The diradical character of the *p*-benzyne is well established. However, recent experimental result on the nucleophilic addition to *p*-benzyne by Perrin *et al*. seemed to suggest a zwitterionic character of *p*-benzyne. To understand this mechanistic dichotomy, a combined experimental and computational approach was undertaken to study the substituents' effect on addition to unsymmetrical *p*-benzynes by nucleophiles, which can lead to two regioisomers. Achieving high regioselectivity has synthetic utility, as functionalized aromatic product (like haloarenes) arising from a non-aromatic enediyne-core are important synthones. In **Chapter 2** we have studied the effect of para substitution and 'N'-protecting group in benzo-fused unsymmetrical azaenediyne towards regioselectivity. A computational model based on electrostatic potential map has been proposed to explain the observed regioselectivity [regiomeric excess (*re*) in the range of ~5–25%] qualitatively. This result suggests that through-bond effect was marginal and the selectivity mainly arises from surface electrostatic potential difference around two radical centers of *p*-benzyne. Inspired by this result we next synthesized different ortho alkoxy-substituted enediynes which produced high regioselectivity (>99%) in halide addition (**Chapter 3**). To further explore its synthetic potential, a one-pot regioselective halogenation of *p*-benzyne via BC/ Suzuki-Miyaura coupling of the resulting haloarene was carried out. This is described in **Chapter 4**. In **Chapter 5**, a DFT-based calculation on the mechanism of two competitive reaction paths GBC vs intramolecular 1,5-H shift in case of base-induced reactivity of bis-propargyl ethers is described.



Keywords: Bergman cyclization, Garratt-Braverman cyclization, *p*-benzyne, regioselectivity, one-pot, DFT, electrostatic potential, diradical, zwitterion