Control of Reactivity and Selectivity through Ion Pairs in Pericyclic Reactions

1st supervisor: Oliver Reiser 2nd supervisor: Julia Rehbein

Topic: Monocyclopropanated pyrrols and furans are readily available in diastereomerically and enantiomerically pure form[139,140,P5/1] In previous work we demonstrated that both, the *exo*- as well as the *endo*-C/C-bonds of the cyclopropane ring can be selectively activated, leading via ring-opening to valuable chiral heterocycles with relevance in medicinal chemistry.[139–141,P5/2] More recently, we found that ring opening can be affected thermally via pericyclic pathways or transition metal catalysis with or without a preceding one electron oxidation, and the resulting intermediates can be intercepted with appropriate trapping reagents.[142–144]

Aim of the Project: The central question of this project is whether one can alter the reaction pathway of the title reactions through ion pair interactions, this way changing both sterics as well as electronics of the intermediates. Especially, we question if *(a)* one can activate (i.e. lower reaction temperature) or even alter the thermal [3+2]-cycloaddition pathway, which we could show in preliminary work to be feasible with appropriate dienophiles at temperatures of above 150 °C,[142] by dipol-ionpair interactions.[145] Conceivable would be an orbital forbidden [5+2]- or orbital allowed but hitherto unknown [5+4]-cycloaddition pathway through steric shielding of the 1,3-positions within an ion pair and/or switch to a stepwise rather than concerted pathway or *(b)* to effect the analogous, hitherto unknown 5π-electrocyclic ring-opening by a preceding one-electron oxidation (e.g. by tetracyanoquinodimethane (TCNQ) or related oxidants that are readily reduced to radical anions) through electronic and steric stabilization of the proposed radical cation intermediate through ion pairing.

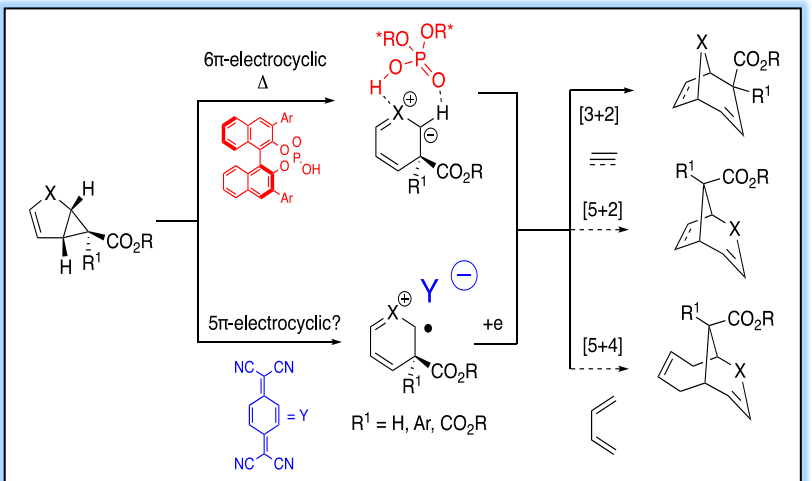

Figure P5: Ring-opening of monocyclopropanated heterocycles mediated by ion pair interactions.

Within this project, PhD students will receive training in a broad range of areas such as stereoselective synthesis, spectroscopy (EPR, transient spectroscopy, NMR) and mapping reaction pathways with the aid of computational chemistry.

Connections within the RTG: Julia Rehbein (computational chemistry and EPR spectroscopy), Patrick Nürnberger (transient spectroscopy).

P5/ 1) J. Yedoyan, N. Wurzer, U. Klimczak, T. Ertl, O. Reiser, *Angew. Chem. Int. Ed. Engl.* **2019**, *58*, 3594-3598.

P5/ 2) J. Fu, N. Wurzer, V. Lehner, O. Reiser, Huw M. L. Davies, *Org. Lett.* **2019**, *21*, 6102-6106.