

Synthetic and Mechanistic Studies in Enyne Metathesis

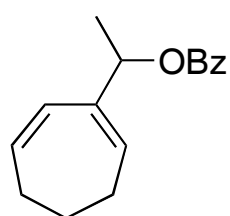
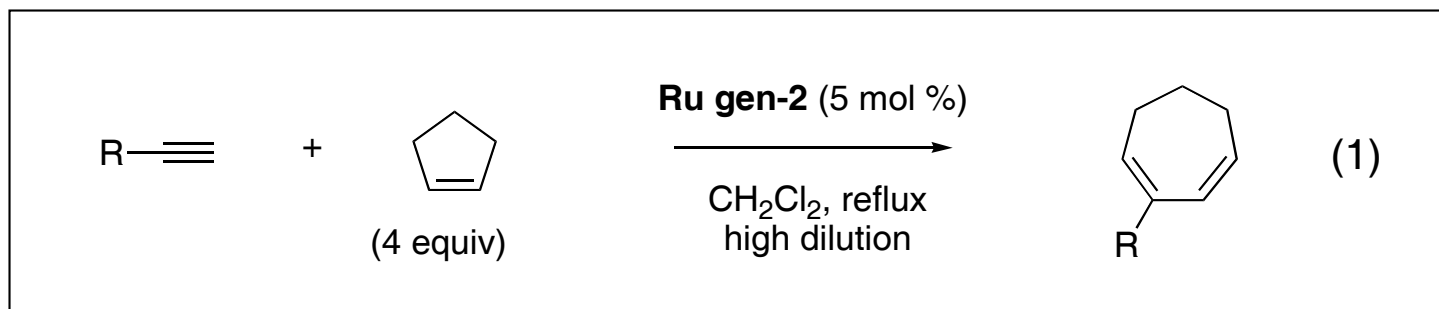
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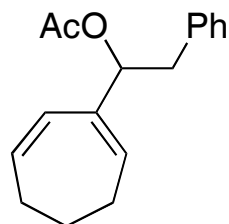
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Enyne metathesis is a powerful method for the synthesis of 1,3-dienes. The intermolecular enyne metathesis between alkenes and alkynes offers an efficient and selective method for the synthesis of acyclic dienes. Our group developed an enyne metathesis between alkynes and certain cycloalkenes or 1,4-dienes to provide cyclic dienes of varying ring size. We termed this reaction a methylene-free enyne metathesis. Some of our group's recent findings will be presented in both the methylene-free ring synthesis and in the cross enyne metathesis. Since the ISOM16, we have been studying the kinetics of enyne metathesis in collaboration with Professor Jerry Keister (UB). We will present our current understanding of the catalytic reaction mechanism using the Grubbs catalysts, discuss new ligand-promoted carbene insertion chemistry and finally present a method for the facile removal of the metal complex at the end of a metathesis reaction.

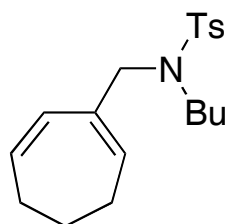
Site- and Regioselective



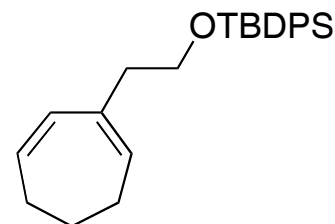
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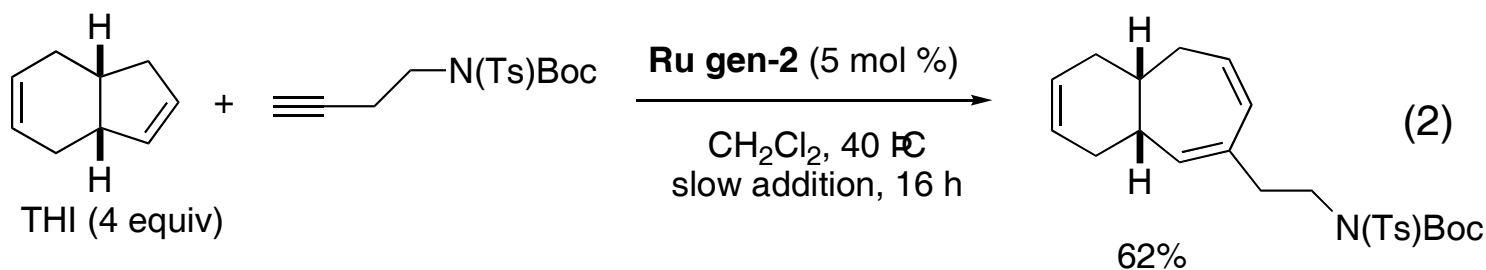
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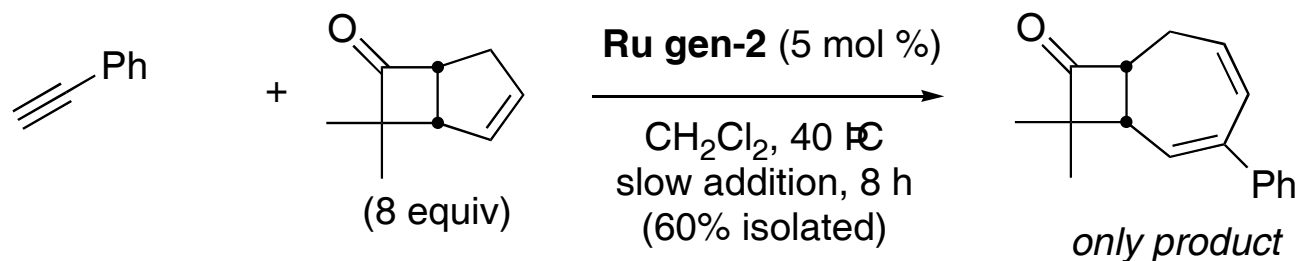
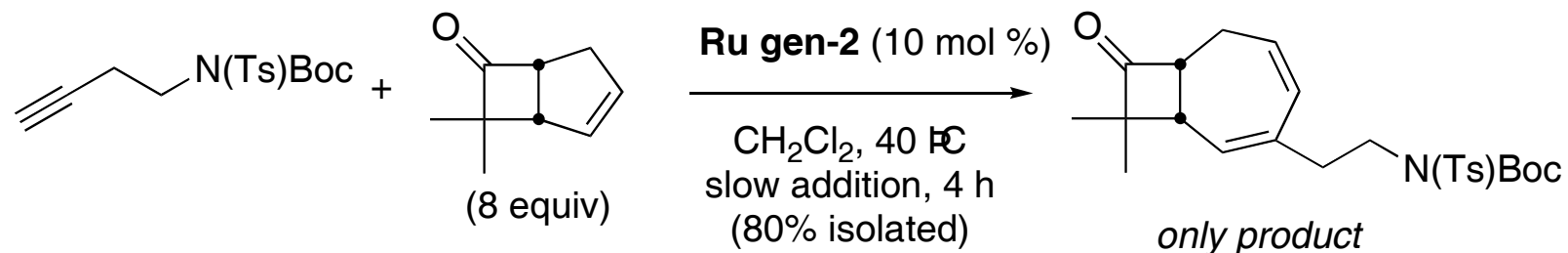


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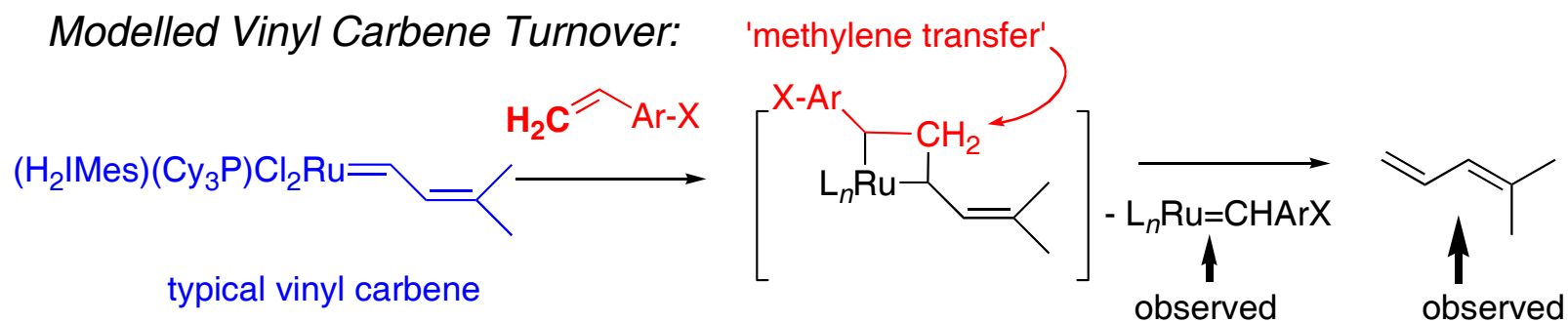
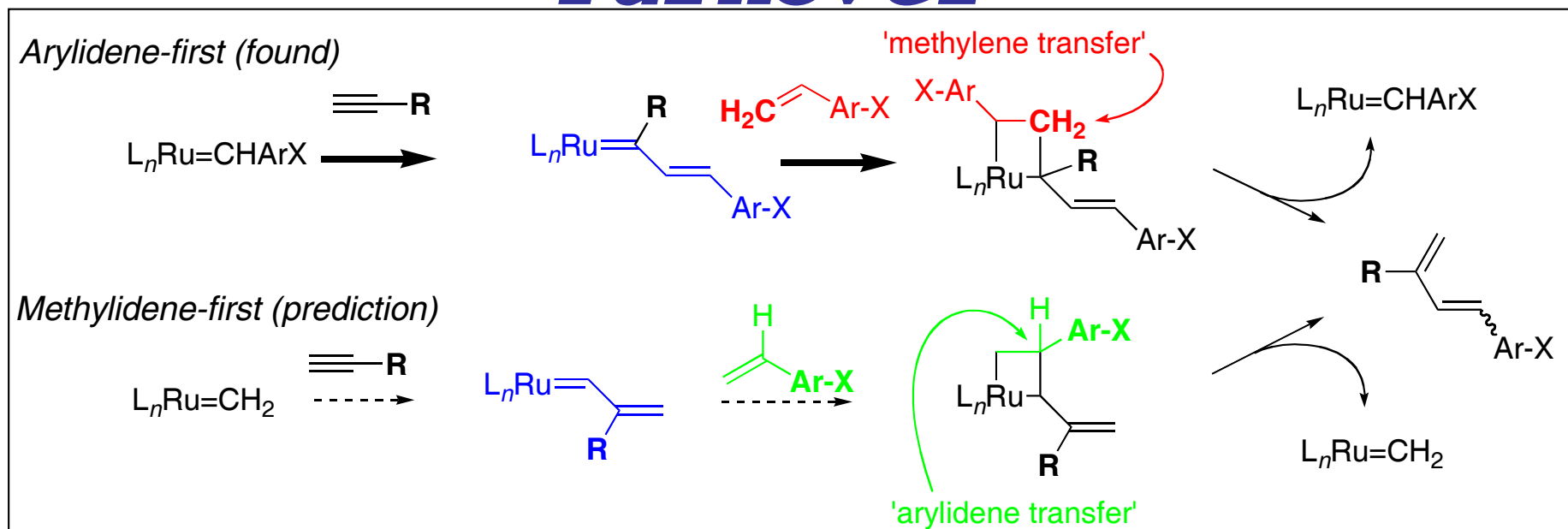
Eq 1: Previous cyclopentene ring expansion to cycloheptadienes: Kulkarni, A. A.; Diver, S. T. *Org. Lett.* **2003**, *5*, 3463-3466. Eq 2: Kulkarni, A. A.; Diver, S. T., *unpublished*.

Ring Expansion in Bicyclics



- Single regioisomer
- Higher catalyst loading for complete conversions
- Further studies: alkyne and FG scope

Modelled Vinyl Carbene Turnover

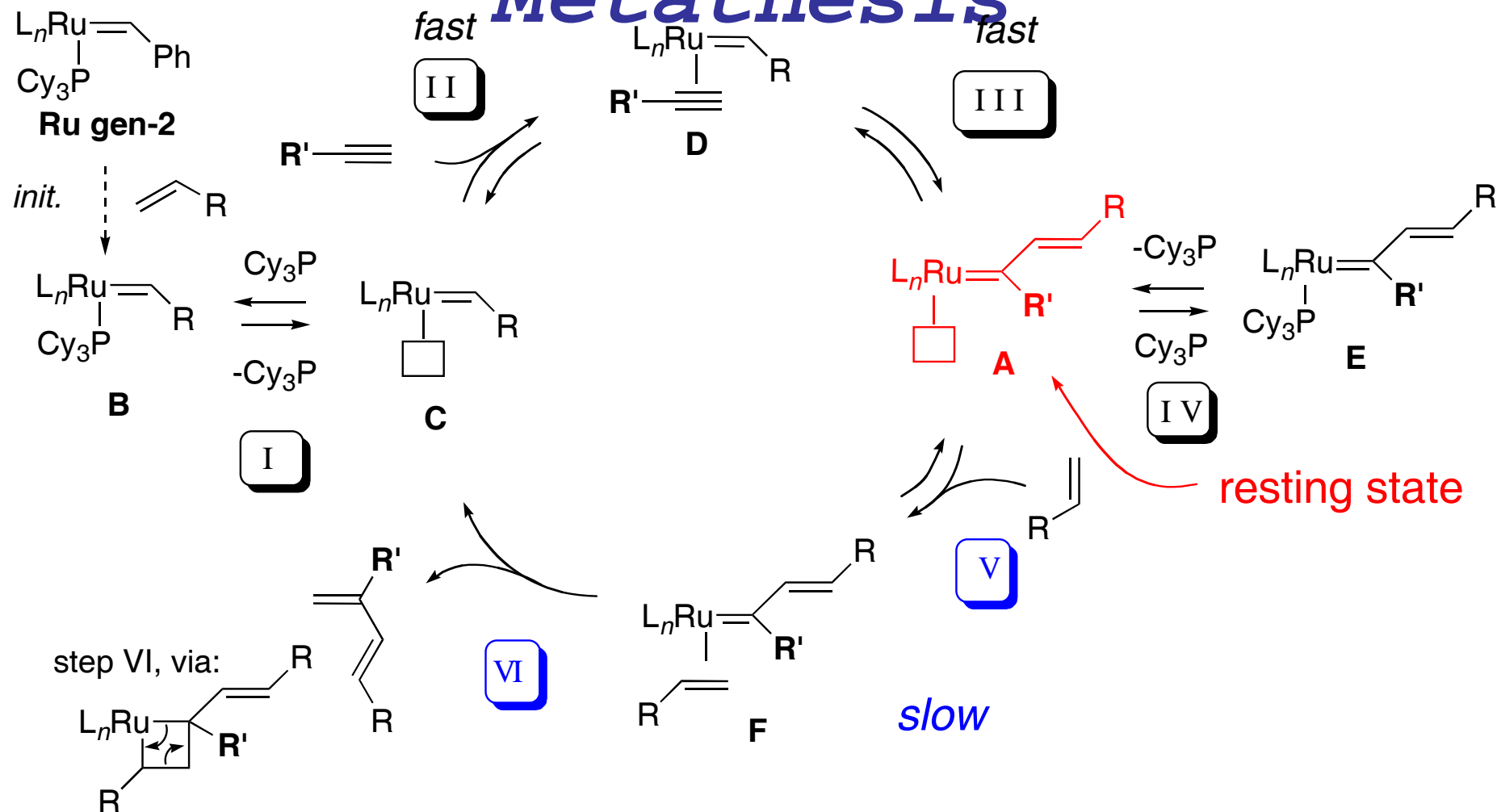


- Found only one regiochemistry consistent with vinyl carbene-CH₂-transfer

Giessert, A. J.; Diver, S. T. *Org. Lett.* **2005**, 7, 351-354.

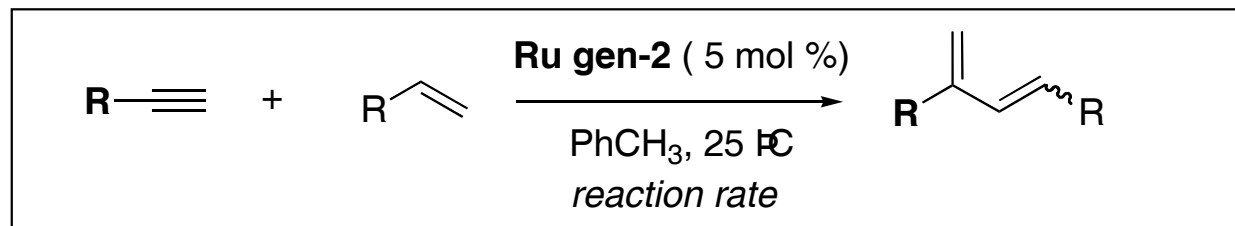
Mechanism of Enyne

Metathesis

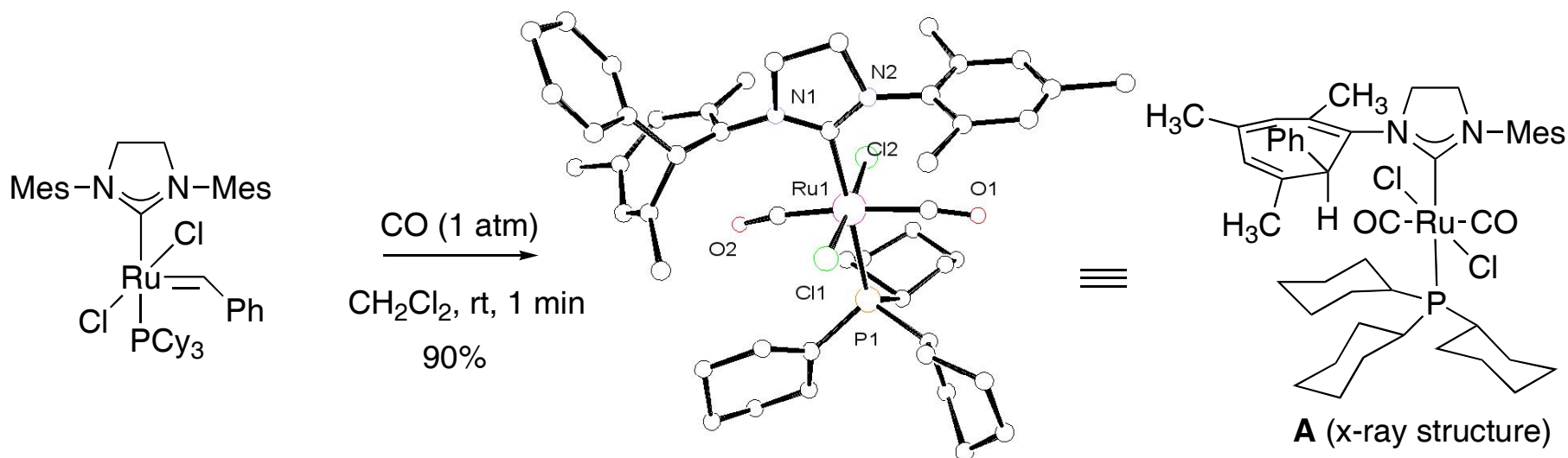


- For 1-alkenes; 'Alkylidene-first' mechanism; Rate-determining steps are V, VI
- Vinyl carbene intermediate: Stragies, R.; Schuster, M.; Blechert, S. *Angew. Chem., Int. Ed.* **1997**, 36, 2518. Early proposals: (1) Kinoshita, A.; Mori, M. *Synlett* **1994**, 1020. (2) Mori, M.; Sakakibara, N.; Kinoshita, A. *J. Org. Chem.* **1998**, 63, 6082.

CO Quench Gives New Product



- Required rapid quenching for kinetic analysis
- CO addition immediately kills catalysis
- Yellow complex isolated from Grubbs' **Ru gen-2**



Galan, B. R.; Gembicky, M.; Dominiak, P. M.; Keister, J. B.; Diver, S. T.
J. Am. Chem. Soc. **2005**, *127*, 15702-15703.

Diver Research Group

Other Recent Work

- Development of polar isocyanide to quench metathesis and to remove ruthenium(II), see: Galan, B. R.; Kalbarczyk, K. P.; Szczepankiewicz, S.; Keister, J. B.; Diver, S. T. *Org. Lett.*, **2007**, 9, 1203-1206.
- Identification of a competing pathway in enyne metathesis: Diver, S. T.; Kulkarni, A. A.; Peppers, B. P.; Clark, D. A. *J. Am. Chem. Soc.* **2007**, 129, .
- Use of tandem Claisen rearrangement to extend the utility of the diene synthesis: Clark, Kulkarni, Kalbarczyk, Schertzer and Diver, *J. Am. Chem. Soc.* **2006**, 128, 15632-15636.
- Improved functional group scope in the methylene-free ring synthesis of 1,3-cyclohexadienes: Peppers, B. P.; Kulkarni, A. A.; Diver, S. T. *Org. Lett.* **2006**, 8, 2539-2542.

Acknowledgements

Research Group

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Collaborators

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Dr. Steven Szczepanekiewicz
(ICP, Canisius College)

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