

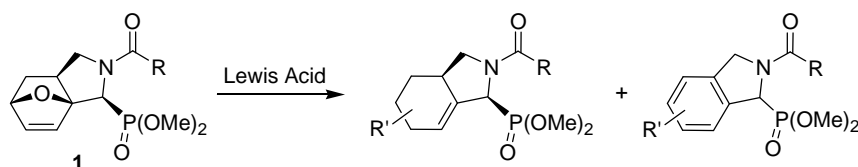
Cleavage of the Oxanorbornene Oxygen Bridge with Lewis Acids: Computation and Experiment

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Since the discovery of the biological activity of aminophosphonates, research started on the synthesis of more constraint azaheterocyclic phosphonates. We developed a route via an intramolecular Diels-Alder reaction towards α -aminophosphonates **1**. [1] The obtained oxanorbornene skeleton is a valuable synthetic intermediate that has been used in various natural product syntheses. [2] An important synthetic transformation involves the cleavage of the oxygen bridge, used to construct substituted arenes and cyclohexenes. We wanted to investigate the ring opening of adducts **1** using different Lewis acids experimentally and get more insight in the reaction pathways towards the different products via computational experiments. In this presentation the results obtained with TiCl_4 and FeCl_3 catalyst are shown.



The computational study started with the catalysts and their multiplicity. Next, the complexation energy with different binding sites was calculated. Therefore, a level of theory study was done using an ONIOM QM/QM approach. This shows the importance of the inclusion of electron correlation effects. B3LYP geometries and energies can be used as a good approximation. Bidentate coordination towards the most electronegative phosphonate oxygen and the oxygen bridge is favoured for both catalysts. Then, different reaction pathways were investigated via a static, gas-phase approach. The energy barrier towards the transition state using the TiCl_4 catalyst, shown in Figure 1, is much lower than for the FeCl_3 catalyst and very different products are formed. The computational results were compared with the experiments.

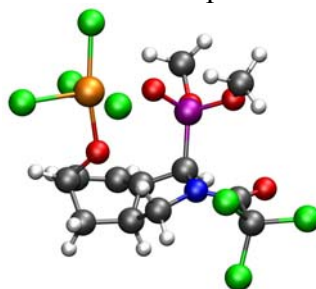


Figure 1: TiCl_4 transition state

[1] D. Claeys et al. *J. Org. Chem.*, 73, 7921 (2008).

[2] P. Vogel et al. *Tetrahedron*, 55, 13521 (1999).