

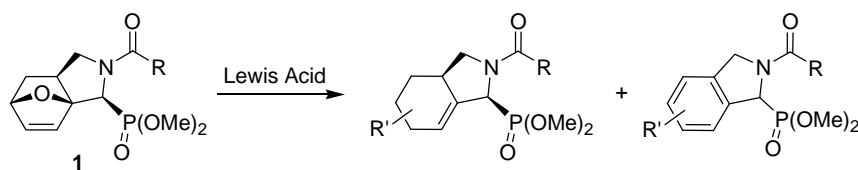
## Cleavage of the Oxanorbornene Oxygen Bridge with Lewis Acids: Computation and Experiment

D. D. Claeys,<sup>a),b)</sup> K. Moonen,<sup>a)</sup> B. I. Roman,<sup>a)</sup> P. Van De Caveye,<sup>a)</sup>  
V. Van Speybroeck,<sup>b)</sup> M. Waroquier<sup>b)</sup> and C. V. Stevens<sup>a)</sup>

a) *Research group SynBioC, Department of Organic Chemistry, Faculty of Bioscience Engineering, Coupure Links 653, 9000 Gent*

b) *Center for Molecular Modeling, Proeftuinstraat 86, 9000 Ghent Ghent University, Belgium*

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  $\alpha$ -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  $\text{TiCl}_4$  and  $\text{FeCl}_3$  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  $\text{TiCl}_4$  catalyst, shown in Figure 1, is much lower than for the  $\text{FeCl}_3$  catalyst and very different products are formed. The computational results were compared with the experiments.

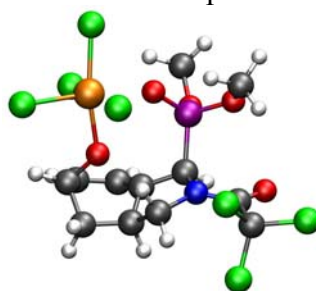


Figure 1:  $\text{TiCl}_4$  transition state

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

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