Frustrated Lewis pair chemistry

Douglas W. Stephan¹ and Gerhard Erker²

¹Department of Chemistry, University of Toronto, 80 St. George Street, Toronto, Ontario, Canada M5S3H6
²Organisch Chemisches Institut, Westfälische Wilhelms-Universität, 48149 Münster, Corrensstr. 40, Germany

Frustrated Lewis pair (FLP) chemistry, a concept that has emerged in the last decade, presents unique systems capable of metal-free hydrogenation by using simple combinations of cooperative main group element components. This finding is particularly interesting given that hydrogenation is a chemical reaction that is performed on a huge scale worldwide with current technologies relying on metal-based catalysts. Over the last 10 years, the range of FLP catalysts has been probed and expanded. At the same time, the concept has also been exploited to employ simple combinations of main group reagents to activate a range of other small molecules. In some cases, these have afforded new avenues and uniquely metal-free routes to desirable materials transformations. In addition, the concept of FLPs has found application in the development of models for some enzymatic systems, new transition metal chemistry and in the description of unique surface chemistry that has led to the discovery of new heterogeneous catalysts.

This issue of Philosophical Transactions A is focused on this area of chemistry. The articles herein cover a range of aspects of FLP chemistry. We begin with a conceptual consideration of the broader context of FLP chemistry by Fontaine & Stephan [1] and then Bullock & Chambers [2] provide an overview of the notion of FLP chemistry across the periodic table. Grimme and co-workers [3] provide a discussion of the theoretical considerations of the quintessential reaction of FLPs, the activation of H₂, while Erker and co-workers [4] report on the development of FLPs derived from carbon-Lewis bases and boron-Lewis acids. Melen and co-workers [5] discuss reactions of FLPs inspired by biologically relevant systems and Uhl and co-workers [6] describe aluminium-phosphorus based FLPs. Gowda & Chen [7] apply FLPs in selective polymerizations of butyrolactones.
Gabbaï and co-workers [8] report on efforts to combine carbon-Lewis acids with phosphines, while Stephan and co-workers [9] describe the use of gallium and indium Lewis acids in FLP chemistry. The issue is concluded with an article by Ashley and co-workers [10] in which they describe the activation of H₂ by a tin-based Lewis acid.

Together these articles give a snapshot of a number of areas in which the concept of FLP chemistry is being developed, applied and used to understand new metal-free approaches to synthetic chemistry and catalysis. The range of chemistry reported in this FLP-issue of Philosophical Transactions A signals both the impact of the last decade of FLP chemistry and the promise of the coming years. While the advent of this new area of chemistry has altered the paradigm of reactivity and catalysis, we have no doubt that new and even more exciting findings will emerge in the future. Indeed, the best is yet to come.

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References