

1) Homogeneous catalysis

The group is especially interested in the development of highly active catalyst systems that at the same time exhibit high selectivities. Homogeneous Ziegler-Natta catalysts often show this specific combination of characteristic features. The synthesis of new ligand frameworks and the development of novel activation procedures is actively pursued by the group. Detailed mechanistic studies to determine the general as well as the specific rules of operation of such catalysts represent another important area of the experimental activities of the group at Münster.

2) Metal catalysed polymerisation reactions

The group is interested in alkene polymerisation reactions that lead to new materials. Our studies on the formation of elastomeric polyolefins by means of controlling the conformational properties of group 4 metallocenes are a typical example. The group is also investigating various copolymerisation reactions, especially those concerning the formation of functionalised polymers by means of coordination polymerisation reactions. We have contributed a series of new types of “constrained geometry catalysts” to the literature that are useful in copolymerisation.

3) Frustrated Lewis Pairs: metal-free dihydrogen activation and more

This is currently the most actively pursued research area in the Erker group. The activation of dihydrogen is usually a domain of metal containing chemistry. We have contributed a series of metal-free dihydrogen activating systems in the course of a currently very active development in chemistry. The most active system of this kind from our group is an ethylene bridged bulky phosphane/borane pair, in which the boron Lewis acid and the phosphorus Lewis base only feature a weak intramolecular interaction. This and a variety of related systems activate dihydrogen under very mild reaction conditions. Some of these systems have served as active metal-free hydrogenation catalysts of functionalised olefins (e.g. enamines, silyl enoethers) and of bulky imines at room temperature. These systems also cleanly and reversibly add carbon dioxide. This new field is expanding rapidly and we find surprising new reactions over and over again.

4) Carbon-carbon bond activation

The activation of strong carbon to element bonds is of great significance in chemistry. Quite recently the group has found first examples that indicate that strong unactivated C-C bonds can be cleaved by reacting them with very electrophilic boron Lewis acids. We have used the 1,1-carboboration reaction of internal alkynes to cleave non-activated strong C-C sigma-bonds and we have found protocols that allows for the insertion of a borylene unit into a C=C double bond in the course of a formal 1,1-carboboration reaction of an alkene.