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The Design of a Phosphine/Phosphenium FLP

Maxemilian Nascimento
nascimem@uwindsor.ca

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The “main group” of the periodic table refers to elements within the s- and p-block. These elements display an incredible variety of properties and thus have many uses industrially, such as components within electronics or in the production of polymers, to name a few. Our research group has been interested in the development of new configurations and bonding motifs for some main group elements within the p-block. These are often cationic phosphorus containing molecules which have the ability to act as ligands to transition metals or dyes. More recently we have been looking at synthesizing molecules for the activation of small molecules such as H$_2$ or CO$_2$. This process is often done using transition metal catalysts but in recent years has been shown to be viable through the use of Frustrated Lewis Pairs (FLPs), which do not contain any transition metals. These molecules contain both a Lewis acid and a Lewis base that are sterically hindered from forming a classic adduct and thus have a lot of built up energy which can be harnessed for reactivity.

The focus of my project is exploring N-Heterocyclic Phospheniums (NHPs) as Lewis acids in an FLP. FLPs often contain boranes as the Lewis acid and phosphines as the Lewis base but there has been no evidence of a phosphenium acting as the Lewis acid. These investigations into different NHPs and their ability in FLP chemistry were performed using air and moisture free techniques. Multinuclear Nuclear Magnetic Resonance (NMR) spectroscopy was used to characterize the compounds. Future applications of these results can include exploring different phosphines or NHP backbones to test different reactivity with small molecules.