Catalytic Olefin Polymerization Using Brookhart-type Catalysts

Background

Since the 1950's a vast amount of research has been conducted on methods and catalysts for making poly-olefins such as polypropylene (PP) and polyethylene (PE), because of their applications and industrial uses. The importance of this research is underlined by the 1963 Nobel Prize in Chemistry to Ziegler and Natta for their work on titanium catalysts that can be used for polymerization of propylene with a very high degree of control. In 1998 Maurice Brookhart[1] presented a new class of catalysts based on iron(II) and cobalt(II) complexes with a tridentate ligand with bulky substituents (figure 1), and demonstrated that these catalysts are extremely active and long-lived in polymerizing ethylene.

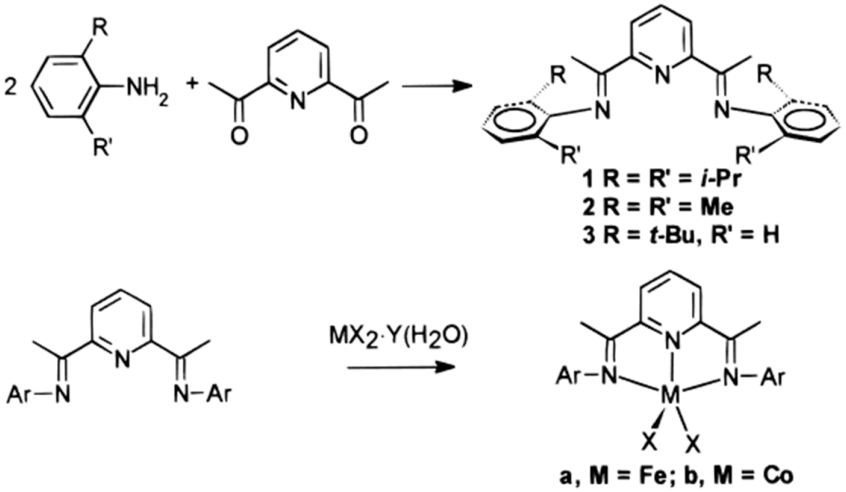

Figure 1 *– The general two-step synthesis of Brookhart-type catalysts.*

In the years that followed, numerous articles have been published on the polymerization of different olefins, using these catalysts and studying their behavior. Besides ethylene and propylene, it was shown that Brookhart catalysts are also active in polymerizing acetylene / ethyne (figure 2), yielding semi-conductive oligomers and polymers with other interesting properties[2]. In more recent years, similar catalysts with different metals, such as nickel and palladium, have been reported[3].

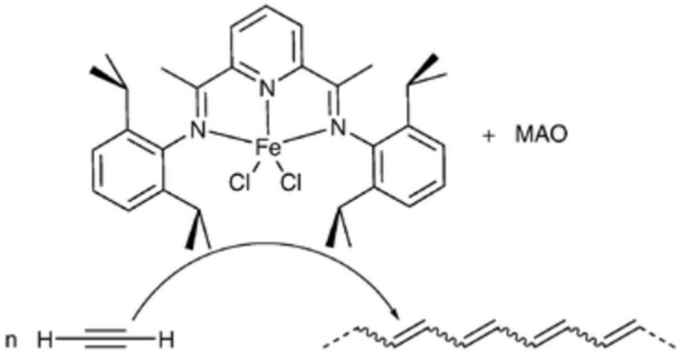

Figure 2 *– polymerization of acetylene using a Brookhart catalyst.*

Internship goal

The goal of this BSc internship is to optimize and extend an existing undergraduate experiment by (1) comparing literature procedures for ligand syntheses with the objective of providing a more robust one and (2) synthesizing cobalt and nickel analogues of currently used iron(II)-based catalyst and investigating the influence this change has on the catalyst's polymerization behaviour towards ethylene and acetylene.

1. *J. Am. Chem. Soc.* **1998**, 120 (16), 4049–4050
2. *Chem. Commun.* **2011**, 47, 6945-6947
3. *Polym. Chem.* **2019**, 10, 2354-2369