Linear Alpha Olefins are molecules that consist of a straight alkane chain of varying length and an olefin or a double bonded carbon atom at one terminus as depicted.

Figure 1. A drawing of a linear alpha olefin using R to denote varying chain lengths.

Over 2.5 million tons of linear alpha olefins are produced annually for use as surfactants, shampoos, synthetic oils, and as co-monomers in a variety plastics such as polyethylene. It is because of their widespread application and importance that research into improving linear alpha olefin production is warranted.

Current linear alpha olefin production methods rely on catalysts that effectively produce alpha olefins from ethylene but do so non-selectively such that expensive purification methods are required to remove undesirable side-products and separate alpha-olefins of different chain lengths. Subsequently, development of a catalyst able to selectively and efficiently produce linear alpha olefins of specific chain lengths would have widespread industrial benefits. It is within this broader context that 8-weeks of summer research was spent developing an effective method to synthesize a theoretically promising cobalt based catalyst.

On going research by Richard Broene and an Honor’s thesis by David Sohoo on cobalt catalysts and linear alpha-olefin production suggested that a cobalt catalyst with a quinoline backbone may have spatial geometry such that it favors selective dimerization of linear alpha olefins. Unfortunately, synthesis of the proposed catalyst proved difficult as one of the reactions needed to synthesize the 2,3,4,5-tetramethyl-1-(8-quinolyl)-cyclopentadiene ligand for the proposed cobalt catalyst typically resulted in very poor yields (~1%) with lots of difficult to purify side-products. It was thus the goal of research during the summer of 2009 to optimize synthesis steps of 2,3,4,5-tetramethyl-1-(8-quinolyl)-cyclopentadiene ligand so that in the fall the cobalt catalyst could be synthesized in sufficient quantity to test whether it is able to efficiently and selectively catalyze alpha-olefin formation from ethylene.

Research into optimizing the production of 2,3,4,5-tetramethyl-1-(8-quinolyl)-cyclopentadiene was successful. After several attempts and time spent investigating possible problems with the synthesis steps it was discovered that by changing the solvent from THF to toluene and conducting the reaction at room temperature to favor the kinetic product instead of at 60°C that the number of side products could be reduced from over 100 to less than 5 and that the final product yield could be improved from ~1% to over 20%.

Work will continue this fall with the synthesis of the proposed catalyst in figure 2 and testing of its ability to selectively form linear alpha olefins from ethylene.

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