Oxidative Desulfurization of Thiophene Derivatives using Metalloporphyrins

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Introduction

- Diesel fuels typically contain sulfur (1-5% by weight)
- Sulfur combustion products contribute to acid rain and poisoning of modern emission control systems.
- US and EU governments call for lowered concentration of sulfur in all fuels.
- The current method, hydrodesulfurization, struggles to remove β-alkyl dibenzothiophenes.
- ODS is a promising alternative or supplementary process.
- This two step process uses an oxidant in a catalytic system to achieve the oxidation of a substrate and then removes the substrate based on polarity differences.
- A variety of catalysts are known to work in ODS.
- Will metalloporphyrins work as catalyst in the ODS process?

The figures to the left depict the effect of a metalloporphyrin catalyst on our oxidation reactions. The catalyzed reactions showed almost complete reactant to product conversion while negligible conversion was observed for the uncatalyzed reactions. These results indicate that the metalloporphyrin was indeed catalyzing the reactions.

Initial experimental results of a model fuel, as seen to the right, showed our reaction could modestly oxidize some of the β-alkyl dibenzothiophenes. Using HPLC data, we were then able to determine the relative ratios of substrate to product.

Our initial reaction conditions often led to incomplete oxidation of the substrate. As we refined technique, our reaction allowed us to oxidize over 95% of the problematic β-alkyl dibenzothiophenes.

As shown on the right, the sulfoxides and sulfone products could be removed from the model fuel by exploiting polarity differences between the starting materials and the reaction products.

Literature Cited


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