Oxazoles and oxazolines are important scaffolds commonly used in pharmaceuticals and optoelectronic materials. Traditionally these heterocyclic compounds are prepared by condensation methodology that suffers from poor reactivity when using electron deficient or sterically crowded reaction partners. Condensation methods also exhibit low tolerance of many functional groups as the reactions use strong acids and high temperatures. This dissertation describes an alternate strategy for the formation of these compounds by employing an epoxide opening followed by oxidation to form the target.

Epoxide opening reactions by primary aliphatic, allylic, and benzylic amines, aminolysis reactions, often achieve high yields regardless of the
Sterics and electronics of the rest of the molecule. The aminoalcohols produced by these reactions serve as an easily diversifiable intermediate. Using mild oxidants such as manganese dioxide or N-bromosuccinimide the aminoalcohol intermediate can form a substituted oxazole or oxazoline. This method offers one of the highest atom economies of any reported synthesis.

Styrene oxide serves as an interesting substrate to explore the regioselectivity of these aminolysis reactions. Many syntheses have been developed that favor the epoxide opening on the less hindered side using aliphatic and benzylic amines, while no reports exist to give a high yield of the other regioisomer. Magnesium perchlorate as a Lewis acid catalyst gives unique selectivity for the regioisomer formed by the opening on the more hindered side of styrene oxide. This regioselectivity, however, is eroded by the presence of even stoichiometric amounts of water.

The reactivity of phenanthroline and phenanthrene aminoalcohols is further explored in the optical sensing of chemical warfare agents. As alcohols readily react with phosphorus halides, these aminoalcohols could be used as sensors for organophosphorus nerve agents such as Soman. This is explored for the reaction between the aminoalcohol and a nerve agents mimics by both optical spectroscopy and nuclear magnetic resonance spectroscopy.