

Sustainable Polyurethanes

Polyurethanes are strong, flexible, multi-component materials with a wide array of uses in consumer products. The largest component of a polyurethane by weight is a polyol, a long-chain molecule that has two or more OH units along the chain. In a collaboration with researchers at University of Minnesota, we recently demonstrated the synthesis of polyurethanes incorporating polyols derived from renewable resources.

Dihydrocarvone and carvomenthone, ultimately derivable from orange peels and other natural products, can be converted to lactones via Baeyer-Villiger oxidation.

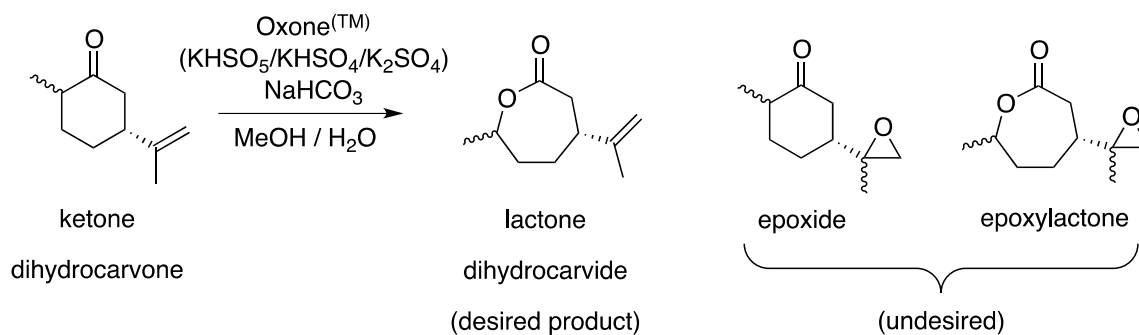


Figure 1. Reaction scheme showing an array of products in the oxidation of dihydrocarvone.

Treatment of these monomers with Lewis acidic catalysts results in the formation of "statistical co-polymers" via ring-opening trans-esterification polymerization.

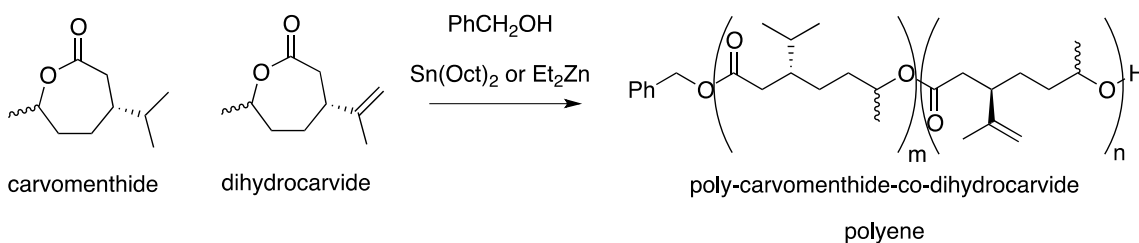


Figure 2. Copolymerization of carvomenthide and dihydrocarvide.

Modification of the olefinic groups on the dihydrocarvide units is possible through a thiol-ene reaction.

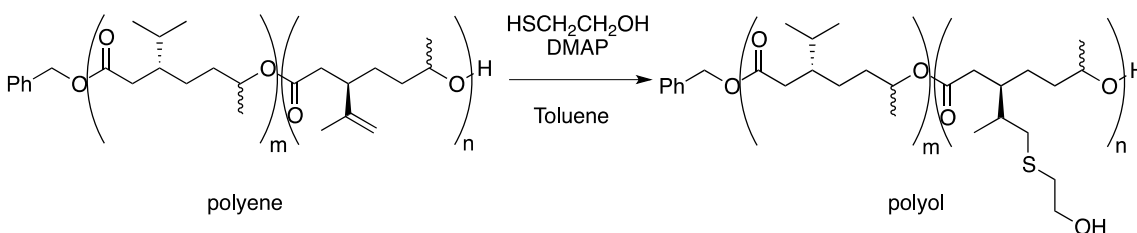


Figure 3. The use of the thiol-ene reaction to provide a polyol.

Treatment of the resulting polyol with a diisocyanate and a chain extender results in the formation of polyurethane with promising mechanical properties.

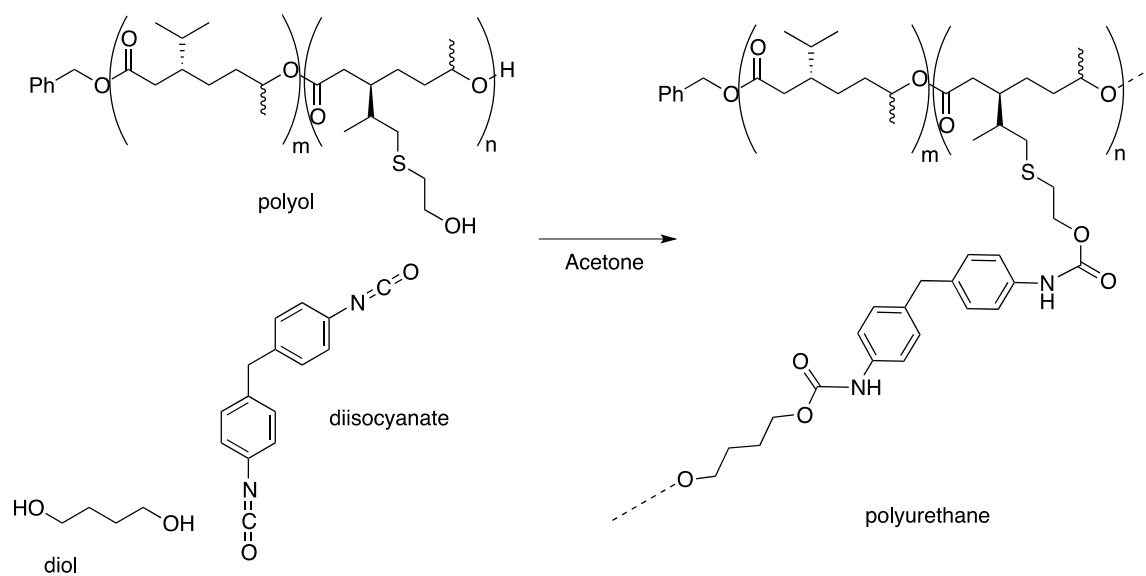


Figure 4. Partial representation of polyurethane formation.

In a continuation of this project, we will investigate the possibility of forming a polyamine analog for the formation of polurethane urea, and determine whether the stronger urea linkages confer improved physical properties on the resulting material.

