Title: Developing bioderived CO_2-responsive polymers as alternatives to petroleum-based polymers

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Petroleum-based materials have become a societal necessity but also put a significant burden on the environment. Billions of kilograms of petroleum-based polymers are manufactured each year from crude oil, which is a depleting resource. Changes are required to slow this depletion and reduce the dependency on petroleum-based materials. To achieve these goals, society must look to sustainable alternative materials to supplement the demand for petroleum-based materials. Sustainable materials have skyrocketed in popularity in recent years but are still in their infancy stages, so there is room for improvement and new materials. However, these new bioderived materials come with expectations; the performance of bioderived materials needs to match or surpass petroleum-based materials while being cost-effective.

Substituting petroleum-based materials with biobased materials is expected to mitigate some of the harm done to the environment, but to make a significant impact, improvements to the recycling of materials are also required. The big issues with polymer recycling are contamination from other polymers, or it's not economically worth recycling the polymer in the first place. A simple and cost-effective recycling technique is required to make these problems non-issues. A potential solution to making recycling easier is using CO_2-responsive materials. CO_2-responsive materials can reversibly switch between two properties when in the presence or absence of CO_2 and water. Adding CO_2-responsive moieties to these bioderived polymers allows the polymer to be dissolved in carbonated water but precipitated when CO_2 is removed. Using this mechanism, bioderived CO_2-responsive polymers can be separated and recycled from non-responsive polymers.

In this seminar, I will be discussing the design, synthesis, and testing of bioderived CO_2-responsive polymers as petroleum-based polymer alternatives in applications such as pressure-sensitive adhesives and expanded polystyrene foam packaging. Using guidance from the 12 principles of green chemistry, monomers and polymers were synthesized using renewable materials like castor oil and vanillin and then polymerized in carbonated water to minimize organic solvent usage. After polymerization, the bioderived CO_2-responsive polymers were tested for properties and performance in their respective applications.