

2023 UC Merced Climate Action Research Seed Fund Competition

Over the past century, the development of plastics has revolutionized not only the chemical industry, but also our daily life, by facilitating the replacement of natural building materials with more durable and flexible synthetic materials. Although the increasing use of plastics has led to an improvement of our life in many aspects, the environmental stress caused by producing and disposing of plastics is severe and requires immediate attention. In 2006, over 68% of the plastics produced were manufactured from petroleum-derived sources, and the extensive abuse of fossil fuel is significantly increasing the emission amount of carbon dioxide (CO₂), resulting in an unstable global climate environment. Thus, the development of new types of material with lower environmental impact is an urgent need. Other than polyesters, which are a major biodegradable plastic produced globally, polycarbonates have been noted for their biodegradability and outstanding properties, such as strength, lightness, durability, high transparency, heat resistance and good electric insulation. More importantly, polycarbonates can be prepared by using CO₂ as a comonomer, which is well-known as an abundant, inexpensive, and non-toxic biorenewable resource.

California Climate Priority

California Air Resources Board 2022 Scoping Plan

Our research plan directly addressed the goals of the California Air Resources Board 2022 Scoping plan by proposing the reduction in greenhouse gas emissions through conversion of CO₂ directly into valuable polymer materials. Our work will contribute to a circular carbon economy by: a) reducing emissions by curbing fossil fuel consumption, b) 'sequestering' CO₂ in a polymer with intrinsic economic and societal value and, c) reducing energy consumption using a catalyst based upon an earth abundant element (boron).

Actionable Project Outcome

The successful completion of the project will lead directly to a new technology to combat climate change by using the potent greenhouse gas (CO₂) as a precursor to valuable and industrially relevant polycarbonates. We plan to patent this method and (see below) seek out end-user partners to help commercialize this technology. Thus, actionable outcomes not only include reduction in greenhouse gases, but also the stimulation of economic development in the region and across the state.

Inclusion

The PI's research lab is a diverse team of scientists which is gender balanced and features underrepresented groups in STEM which will ensure a diversity of perspectives in tackling research challenges. The PI will publish results in open-access journals to maximize accessibility.