SUMMARY / ABSTRACT FOR PUBLIC RELEASE

Title – Scaling an integrated process for biopolymer production using lignocellulosic feedstocks

Applicant – ZymoChem, Inc.

Principal Investigator – Harshal Chokhawala, Ph.D.

Major Participants – ZymoChem, Inc.; Lawrence Berkeley National Laboratory (LBNL); National Renewable Energy Laboratory (NREL)

Project Description

At ZymoChem, our mission is to develop economically viable bioprocesses for the production of chemicals that supplant current petrochemical-based materials. To enable a more circular hygiene industry, we are developing bio-based Super Absorbent Polymers ('Bio-SAP') that are low-cost, environmentally safe, high-performing, biodegradable, and also able to be made using lignocellulose-derived sugars. Incumbent petrochemical-based SAPs (fossil-SAP) constitute a global market size of $10 billion/year, of which >80% is used in hygiene products. The vast majority of fossil-SAP is made with poly(acrylic acid) or poly(acrylamide), each of which has unsustainability concerns (derives from oil), toxicity issues (acrylamide is a known carcinogen), and lack biodegradability (~500 years to decompose). Suffice to say, there is a dire need for a Bio-SAP in order to decrease the use of petroleum-derived consumer products and reduce greenhouse gas emissions that comes from their production.

Production of ZymoChem's novel Bio-SAP occurs through two sub-processes. The first process involves the microbe-based fermentative production and subsequent purification of a naturally occurring biopolymer that is biodegradable, edible, and non-toxic. The second process involves crosslinking this biopolymer with chemicals also made from bio-based feedstocks in order to produce a 3-dimensional SAP network with desired absorbency properties and which also completely biodegrades. For this project, ZymoChem will work with multiple groups at LBNL to elevate our current integrated fermentation and downstream biopolymer purification process to commercial scale. Our ultimate goal of this 2-year project will be to produce multiple metric tons of purified biopolymer, which will facilitate production of enough Bio-SAP to generate hygiene consumer products containing ZymoChem's Bio-SAP. Achieving this goal will require an iterative, stepwise process in which fermentation and downstream purification operations are optimized at 10-fold jumps in scale (300 L to 3,000 L to 30,000 L). Initial fermentation optimization will rely on both scaled-down and pilot scale fermentations in which media components and process parameters are altered to identify conditions for robust biopolymer production at commercial scale. Multi-omics analysis will be conducted to monitor strain performance & responses to parameter variations, and also to inform on bioreactor conditions that will be required at larger scales. Additionally, we will demonstrate the use of lignocellulosic hydrolsates as feedstocks for Bio-SAP production at the pilot scale, opening the use of these feedstocks commercially. Lastly, data gathered throughout this project will be incorporated into a detailed Life Cycle Assessment model in which we anticipate demonstrating the potential for a significant decrease to the environmental impact and >70% decrease to greenhouse gas emissions of our 100% Bio-SAP versus the petroleum-derived incumbents.