Arizona State University

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Lysis Technologies for Reducing Costs Associated with Cyanobacterial Biofuel Production

AzTE Cases: M08-060, M11-015, M10-180 & M12-068

Inventors

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Invention Description

Cyanobacteria are photosynthetic microbes capable of converting solar energy into liquid biofuel like alkanes and ethanol, and biofuel precursors like free fatty acids. They can be thought of as individual machines efficiently transforming sunlight and CO_2 into fuel, and like machines they can be engineered with new capabilities. Because they are bacteria they are relatively easy to genetically modify compared to plants and even other photosynthetic microbes like algae. Researchers at the Biodesign Institute of Arizona State University have made several innovations increasing both the quantity and quality of biofuel and biofuel precursors, as well as engineering several features into the organism to help reduce the cost of product recovery.

One of these cost reduction features involves the use of lipases that can be produced on command that will digest the cyanobacterial cell wall and free its internal products into the surrounding culture media where they can be collected. This is an entirely genetic based process that reduces or eliminates what has traditionally been done with mechanical means. By engineering the cyanobacteria to “process themselves” costs associated with mechanical means of lysis can be reduced or eliminated.

Researchers have engineered both nickel-inducible and CO_2 limitation-inducible strains. The nickel inducible strains produce holins and endolysins when nickel is added to the cyanobacterial culture. An improvement to this technology, called Green Recovery, replaces the nickel inducible promoter with a promoter tied to low levels of CO_2, thus eliminating the cost and recovery associated with a nickel inducer. Since the cyanobacterial culture requires CO_2 to grow, the simplest method to signal the cells to lyse is to turn off CO_2 aeration. A further improvement uses thermotolerant lipases so that lysis can occur in the dark and with biomass that has already been concentrated (for instance by using the autoaggregation feature described in a separate NCS). This final process is has been termed “thermorecovery” since the lipases start to lyse the cell only when the temperature of the concentrate is raised to 43° Celsius.

Potential Applications

- Biofuel production
- Biomass harvesting
- Microalgae lysis

Benefits and Advantages

- Replacing traditional lysis technologies with a genetic solution
- Lower equipment and energy cost
- Recovery can occur in the dark and at high cell density

Intellectual Property Status:

Patent Pending

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