ALBERTA INNOVATES

CLEAN RESOURCES

BIOINDUSTRIAL INNOVATION

RESEARCH INNOVATION

Engineering Lignin as a Precursor for Carbon Fiber Using Novel Biodegradation and Purification Techniques

Conventional polyacrylonitrile (PAN)-based carbon fibers are costly for large industries, such as the automotive industry. Lignin, a byproduct of many pulp and paper mills, can be an alternative to PAN for some applications. However, the presence of impurities, such as hemicellulose, negatively affects processing and quality of carbon fiber. In support of an overarching target to produce carbon fiber from Alberta-based lignin, the objective of this project is to develop a novel purification technique for generating clean Alberta-based lignin suitable as a precursor for carbon fiber production.

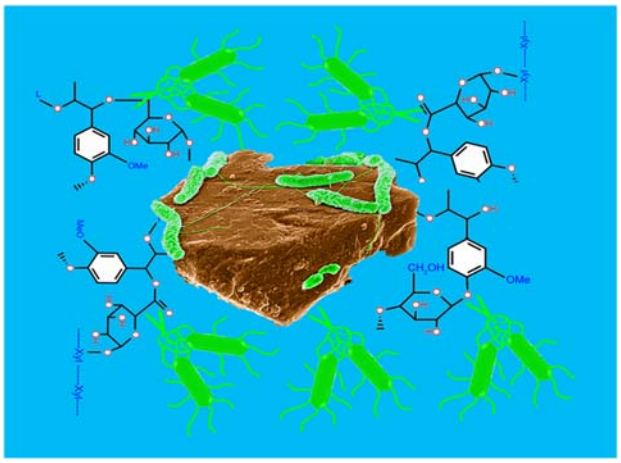

Illustration of biological method to purify lignin

FUNDING DETAILS

RECIPIENT:
University of Alberta

PARTNERS:
InnoTech Alberta

TOTAL BUDGET:
$433,500

AI FUNDING:
$322,500

PROJECT DATES:
AUG 2016 – JULY 2020

PROJECT TRL:
Start: 2
End: 4

APPLICATION

Carbon fibers are commonly utilized in the composite materials industry. Conventional PAN-based carbon fibers are prohibitively expensive for some key industries, such as the automotive industry. Lignin-based carbon fibers present a viable, lower cost alternative to PAN-based carbon fibers for the composite materials industry around the world.

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PROJECT GOALS

This project aims to develop a novel purification technique for generating Alberta-based lignin suitable as a precursor for carbon fiber production that can be an alternative to the currently available PAN-based carbon fibers. The goals are to:

- Develop a technique to provide a purified lignin (hemicellulose-free) through an iterative process involving biodegradation, and characterize the emerging modified lignin.
- Use the bio-cleaned Alberta-based lignin to establish electrospinning parameters for production of carbon fiber precursors.
- Produce and mechanically characterize electrospun lignin-based fibers and subsequently carbonizing these fibers.
- Physically and mechanically characterize the carbon fibers to identify the optimal purification process parameters and compare the obtained data to the previous studies which mainly relied on unmodified lignin.

BENEFITS TO ALBERTA

Economic benefits:

- Production of a value-added product from Alberta's forest resources for the composite materials industry.
- Creation of a new market for Albertan lignin producers.
- Establish new markets for carbon fiber produced from Alberta lignin in sectors such as automotive, construction and battery industries.

Technological benefits:

- Development of novel techniques for lignin purification.
- Advance research knowledge and know-how in the domain of bio-composite materials to help to develop lignin-based carbon fibers in Alberta.

Societal benefits:

- Revitalize and diversify Alberta's economy, with creation of new jobs.

Environmental benefits:

- A new environmentally friendly, sustainable, renewable carbon fiber precursor materials from lignin, a byproduct of pulp and paper mills in Alberta.

5 Publications

3 Students Trained

CURRENT STATUS

DEC 2021

The project has been completed, achieving successful development of a green technology to produce hemicellulose- and defect-free lignin via biodegradation. Production parameters were established and optimized for bio-cleaned Alberta-based lignin as a carbon fiber precursor. The precursor material was successfully carbonized and mechanically characterized. Data obtained during this Project has been compared with results from previous studies of unmodified lignin.