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Multi functional biobased dielectric coolant synthesis using intermediates from ozone cracking of lipids

Bio-derived saturated fatty-acid esters form low-cost, biodegradable dielectric coolants with wide thermal windows, strong breakdown strength, and oxidation stability for EVs and data centers.

Increased fossil fuels and energy use can account for most of the rise in greenhouse gas levels in the atmosphere and contribute to causing other environmental problems as well. In the U.S., more than 50% of greenhouse gas emissions come from the transportation and industrial sectors. In response, governments and institutions have developed guidelines and promoted the design of alternative technologies to help mitigate climate change. For example, one prominent alternative technology is electric vehicles (EVs). However, EVs require batteries to run, which can generate lots of heat during operation and charging, thus requiring the use of dielectric coolants, which help to maintain the battery's optimal operating temperature. Unfortunately, current dielectric coolants are fossil-based and lead to high greenhouse gas emissions during production and disposal. Thus, there is a need to develop renewable bio-dielectric coolants with good low-temperature performance, thermal stability, and oxidation stability. Researchers at Purdue University have synthesized novel renewable bio-dielectric coolants by starting with mixtures of fatty acids that can be reacted with compounds to create fully saturated fatty acid esters with the aforementioned properties. This technology can be used as a renewable bio-dielectric coolant in systems such as electric vehicle batteries, computers in AI data centers, or high-voltage infrastructure to help reduce greenhouse gas emissions and improve sustainability.

Technology Validation:

-Characterized structure and composition using Fourier Transformation Infrared Spectroscopy (FTIR)

-Tested viscosity and effect of temperature on the viscosity for the synthesized bio-dielectric coolants

Technology ID

2025-LIU-71026

Category

Artificial Intelligence & Machine Learning/Computer Vision & Image Recognition
Chemicals & Advanced Materials/Green & Bio-Based Chemistry
Automotive & Mobility Tech/Micromobility & Smart Urban Infrastructure

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-Dielectric constant testing shows that fatty acid ester compounds have comparable electric energy storage according to industry standards

-Dielectric breakdown strength and voltage show comparable values to industry standards

-Melting point analysis and boiling point analysis show a large temperature range for utilization as bio-dielectric coolant

-Oxidation analysis shows no indication of oxidation even after 100 hours of oxidation stability tests

Advantages

-Lower cost of production

-Low energy consumption

-Biodegradable

-High-yield synthesis

-Environmentally sustainable

Applications

-Use for maintaining temperature in batteries or electrical components

-Immersion cooling for computers

-Immersion cooling for high-voltage infrastructures

TRL: 3

Intellectual Property:

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Keywords: Artificial Intelligence, Chemical Engineering, Dielectric Coolants, Electric vehicles, Green Technology, Greenhouse Gas Emissions, Immersion Cooling, Renewable Resources