Compositions and Methods Related Functionalized Cellulose Nanofibrils

Tech ID: 34693 / UC Case 2022-556-0

ABSTRACT

Researchers at the University of California, Davis have developed a one-pot synthesis process for producing hydrophobic, bromine-esterified nanocellulose (Br-CNF) that is dispersible in organic solvents, enabling the creation of enhanced polyurethane composites and serving as a versatile platform for precision polymer functionalization.

FULL DESCRIPTION

This technology features a one-pot method producing Br-CNF directly from cellulose in organic media followed by ultrasonication. By targeting cellulose hydroxyl groups on crystalline surfaces and converting them into organic-compatible 2-bromopropionyl esters, the process renders the material inherently hydrophobic. The resulting Br-CNF features nanoscale dimensions (~4.6 nm thickness, 29.3 nm width, 1 micron length) and maintains high crystallinity (~48%). Its ability to disperse (>25%) in solvents like DMF, DMSO, chloroform, THF, and toluene unlocks new potential for material science, acting as both a mechanical reinforcement and a site-specific macroinitiator for SI-ATRP (Surface-Initiated Atom Transfer Radical Polymerization).

APPLICATIONS

- High-performance polyurethane composites with potentially superior durability that could be useful in automotive and aerospace settings.
- Hydrophobic surfaces and films with tunable wettability for packaging, sensors, and protective layers.
- Rheology modifiers and viscosity enhancers in organic solvent-based formulations and lubricants.
- Biobased polymer brushes for advanced functional materials via SI-ATRP grafting.
- Sustainable, environmentally-friendly, and renewable nanomaterial supply for composites, adhesives, and coatings markets.

FEATURES/BENEFITS

- Enhances polyurethane tensile modulus (up to 3.2×), strength (up to 3.9×), and strain-to-failure (up to 1.5×).
- Enables covalent incorporation into polyurethane matrices as a chain extender or polyol.
- Integrates esterification and disintegration into a one-pot, solvent-compatible process.
- Overcomes the traditional incompatibility of hydrophilic nanocellulose with non-polar and organic material.
- Offers tunable rheological properties for effective viscosity modification in organic fluids.
- Reduces high toxic diisocyanate (MDI) loading required for polyurethane synthesis.
- Provides a renewable, high-performance alternative to traditional petrochemical filters and modifiers.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Published Application	20250188196	06/12/2025	2022-556

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OTHER INFORMATION

KEYWORDS

atom transfer radical polymerization, bromine esterification, cellulose nanofibrils, dispersion, organic media compatibility, polymer composites, polyurethane synthesis, rheology modifier, surface functionalization, ultrasonication

CATEGORIZED AS

- **Materials & Chemicals**
  - Biological
  - Nanomaterials
  - Polymers

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