Direct Production of Sulfated Cellulose Nanofibrils

Tech ID: 34642 / UC Case 2022-552-0

ABSTRACT

Researchers at the University of California, Davis have developed a scalable, one-pot method to produce highly charged sulfated cellulose nanofibrils (SCNFs), which can be wet-spun into continuous, high-strength fibers and serve as effective polyanions in conductive polymer composites.

FULL DESCRIPTION

The invention relates to forming SCNFs by reacting native cellulose with chlorosulfonic acid, followed by washing and mechanical disintegration into nanofibrils. These SCNFs retain cellulose I crystallinity, exhibit tunable surface charge, amphiphilicity, thixotropic and shear-thinning properties, and can be wet-spun with various coagulants into continuous fibers possessing high tensile strength and Young's modulus. Additionally, SCNFs may replace or complement poly(styrenesulfonate) (PSS) as polyanionic templates in aqueous dispersions for in situ polymerization of the conducting polymer PEDOT, substantially enhancing conductivity and dispersion stability through synergistic effects.

APPLICATIONS

- High-performance textile fibers and composites with superior mechanical properties.
- Biodegradable packaging and membranes leveraging SCNF dispersibility and strength.
- Conductive polymer inks, coatings, and films for printed electronics and flexible devices.
- Energy storage devices benefiting from improved mechanical and electrical characteristics.
- Biomedical scaffolds and superabsorbent materials enabled by tunable surface chemistry.
- Leverages abundant agricultural waste and plant biomass.
- Advanced nanocomposites combining SCNF with conductive polymers for sensors, actuators, and wearable electronics.

FEATURES/BENEFITS

- Delivers high-yield sulfated cellulose nanofibrils through scalable, one-pot chlorosulfonic acid treatment.
- Tunes surface charge to control fibril properties. Preserves native cellulose I crystal structure for superior mechanical strength.
- Enables wet-spinning of continuous, high-strength fibers.
- Promotes alignment and enhanced performance with anisotropic rectangular nanofibril morphology.
- Exhibits amphiphilic, thixotropic, and shear-thinning behavior for advanced processing techniques.

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OTHER INFORMATION

KEYWORDS

biomass, chlorosulfonic acid, conductivity, nanofibrils, nanomaterials, polymers, sulfated cellulose, textiles, wet spinning, wireless

CATEGORIZED AS

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

RELATED CASES

2022-552-0

- Replaces or supplements PSS in PEDOT polymerization. Sources nanomaterial sustainably from abundant biomass like rice straw, wheat straw, and wood.
- Overcomes low yields and mechanical issues found in traditional nanocellulose production.
- May avoid the expense and chemical limitations of TEMPO oxidation by using chlorosulfonic acid.
- Solves alignment and assembly challenges when producing macroscale fibers from nanocellulose.
- Provides stable, charged nanocellulose dispersions suitable for solution processing and fiber spinning.

PATENT STATUS

Country	Type	Number	Dated	Case
Patent Cooperation Treaty	Reference for National Filings	WO 2023/14'7190	08/03/2023	2022-552

Patent Pending

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Ultra Light Amphiphilic and Resilient Nanocellulose Aerogels and Foams
- Conductive and Elastic Nanocellulose Aerogels
- Nanocellulose-Assisted Exfoliation of Graphite to Few Layer Graphene
- Nanocellulose-based Aerogel Fibers as Insulation
- Compositions and Methods Related Functionalized Cellulose Nanofibrils
- Method for Producing Amphiphilic and Amphoteric Soy Protein Colloids, Sub-Micron Fibers, and Microfibrils

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