# Coaxial Cellulose-Based Aerogel Fibers

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## ABSTRACT

Researchers at the University of California, Davis have developed a coaxial fiber combining a cellulose fiber exterior sheath and an aerogel interior core enabling strong, lightweight, and highly efficient thermal insulation suitable for both wearable objects and industrial applications.

## FULL DESCRIPTION

This invention provides a continuous coaxial fiber composed of a cellulose-rich porous sheath and an ultra-low density aerogel core, fabricated through wet-spinning and freeze-drying. The exterior sheath contains multiscale pores spanning tens of micrometers to nanometers, serving as a protective template and mass transfer medium. The interior aerogel core offers outstanding porous cellular architecture, greatly inhibiting heat transfer by convection, conduction, and radiation. The resulting fibers exhibit high specific tensile strength, lightweight structure, and wide operational temperature range (−20 to 150°C). They are biodegradable and potentially scalable for mass production, offering promising applications in thermal protective textiles and energy-efficient industrial insulation applications, including for buildings and transportation (e.g., trailers, aircraft, etc.).

## APPLICATIONS

- Wearable thermal insulating textiles and fabrics that are flexible and stretchable for outdoor, sportswear, and medical application requiring thermal regulation.
- Energy-efficient building insulation materials, including fiber mats and panels.
- Lightweight thermal insulation for aerospace, automotive, and transportation sectors.
- Packaging and container insulation to maintain temperature differentials.
- Advanced composites and fibrous structures for industrial thermal management.

## FEATURES/BENEFITS

- Delivers ultralight thermal insulation through high porosity (~85%) and low density (~0.2 g/cm³).
- Improves durability and handling via high specific tensile strength (~20 to 30 MPa·g/cm³).
- Enables efficient aerogel formation and protection improving insulation performance beyond conventional fibers by using a multiscale porous cellulose sheath around an aerogel core.
- Reduces heat transfer by suppressing convection, conduction, and radiation simultaneously.
- Operates across a wide temperature range (−20 °C to 150 °C) for harsh-use environments.

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## OTHER INFORMATION

### KEYWORDS

aerogel, cellulose nanofibril, coaxial fiber, thermal insulation, porous fibers, wet-spinning, biodegradable, mechanical strength, scalable production, breathable textiles

### CATEGORIZED AS

- **Energy**
  - Other
- **Engineering**
  - Engineering
  - Other
- **Materials & Chemicals**
  - Biological
  - Polymers

- Reduces environmental impact by using renewable, biodegradable cellulose-based materials.
- Scalable production via continuous wet-spinning and freeze-drying manufacturing.
- Prevents fragility and low tensile strength typical of aerogels by reinforcing them within a protective porous cellulose sheath.

- Textiles
- **Transportation**
- Other

**RELATED CASES**

2020-030-0

## PATENT STATUS

| Country | Type | Number | Dated | Case |
|---|---|---|---|---|
| United States Of America | Published Application | 20210156051 | 05/27/2021 | 2020-030 |

## 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
- Direct Production of Sulfated Cellulose Nanofibrils
- 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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