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BIOMATERIALS

The Application of Nanocellulose in Flexible and Wearable Energy Storage Devices

The wearable electronic devices market is growing and in need of compact, lightweight and flexible energy storage components. Graphene and carbon nanotubes (CNTs) are the dominant materials used in these devices today. Cellulosic nanofibrils (CNF), a form of nanocellulose derived from woody plant material, shows potential as an advanced alternative material in flexible energy storage devices. Dr. Zhi Li's research team is developing stronger and more flexible energy storage devices. They propose to leverage the unique physical and molecular properties of CNFs to integrate conductive materials such as graphene and increase strength and flexibility compared to conventional energy storage devices.

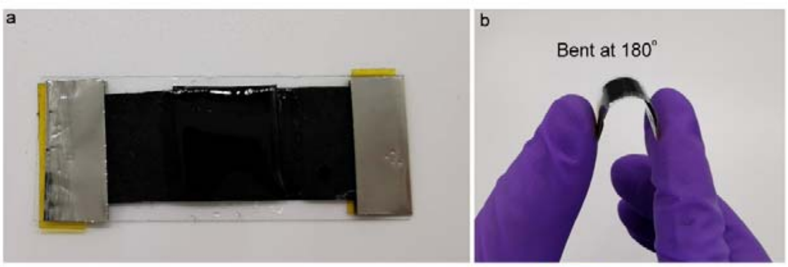

Fig. 3. (a) Photograph of a planar, flexible, solid-state, symmetric supercapacitor fabricated from AC-20CNF-10CNT-10CF electrodes. The stainless steel sheets are used to connect the electrode to external circuits. (b) The as-prepared supercapacitor was bent at 180° for 100 cycles.

FUNDING DETAILS

RECIPIENT: University of Alberta

PARTNERS: Astria Nanotech

TOTAL BUDGET: $433,750

AI FUNDING: $290,000

PROJECT DATES: MAR 2018 - MAY 2021

PROJECT TRL: Start: 2 End: 4

APPLICATION

As a component of flexible energy storage devices, CNFs could increase strength and flexibility of these devices, which are of particular interest to the electronic wearables market. As of 2020, the global flexible battery market was valued at approximately US $100 Million and is expected to triple in value by 2025. Key sectors considered to be driving demand growth include wearable electronic medical devices, miniaturization of electronic devices and Internet of Things.

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PROJECT GOALS

- Invent the flexible electrode technology: develop CNF-based flexible electrodes for supercapacitors; develop CNF-based graphite and $LiCoO_2$ as anode and cathode for flexible Li-ion batteries; optimize composition for flexibility, durability and conductivity; and optimize processing cost.
- Develop planar flexible energy storage device: Fine-tune interplay between CNF, graphene and conductive additives to optimize mass loading and performance of the flexible planar device.
- Develop wearable fiber-shaped energy storage devices with CNF and CNC as electrode components.
- Introduce technologies to investors; and initiate commercialization activities in collaboration with industrial partners.

BENEFITS TO ALBERTA

- Create new, high-value market for Alberta-produced cellulosic nanofibrils.
- Economic diversification in the digital electronics components and wearable energy storage devices, with associated high-quality jobs.
- Attract investment in research and commercialization of flexible wearable energy storage devices and high-power energy devices, such as super capacitors.

3 Publications

1 Student Trained

1 Patent

2 Project Jobs

3-5 Future Jobs

CURRENT STATUS

MAR 2021

The completed project successfully demonstrated that cellulosic nanofibrils (CNF) outperform carbon nanotubules (CNT) and graphene in flexibility. Conductivity was enhanced with producing a matrix material, comprised of CNF, CNT, and carbon fiber (CF) with enhancements including conductive polymer. Production processes were also optimized, with quality and cost in mind. Lithium- and Zinc-ion flexible batteries were fabricated and showed good performance. Further research is needed to improve conductivity for flexible, high power energy storage devices, such as supercapacitors. Engagement with potential investors and industry partners commenced.