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Mini Review

Preparation of Cotton Fiber from Jute Cellulose for Super Capacitor

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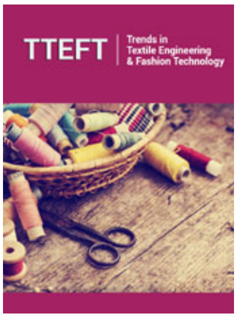

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Abstract

The circular economy and sustainable information and communications technologies are becoming more and more interested in environmentally friendly energy sources and systems. In order to achieve this, a temperature and humidity sensor, a supercapacitor made of natural jute fiber, and an energy-autonomous system are given. To create environmentally friendly electrodes, the jute fibers must be functionalized with conductive components (such as carbon nanotubes and Ag nanoparticles). This is due to the insulating properties of the cellulose and lignin found in jute fibers. The majority of fiber or textile based SCs currently in use metal coated cloth, which has problems like chemical instability due to reaction with electrolytes. Contrarily, the jute fiber may absorb aqueous active electrode inks, such as those based on organic conductive polymer and aqueous nanoparticle carbon, because of its high cellulose content (70%), leading to SCs with increased performance. In this mini review paper, we can easily know about super capacitor also we can know how to be prepared carbon fiber from jute cellulose. Jute cellulose is eco-friendly, easily gettable and more reserve value comes from jute fiber. Developed using sustainable and biocompatible materials, the presented SC can power the jute-fiber based sensors, thus demonstrating an attractive eco-friendly solution for applications such as wearables, grain sacks, and bags. This mini review is helpful all over the world because in this generation works on sustainability where jute cellulose is the best example which is environment friendly.

Keywords: Polyacrylonitrile; Supercapacitor; Biomass; Biodegradable

Introduction

Supercapacitors (SCs) are a new energy storage technology that has gained a lot of attention because to its fast charging/discharging rate, high energy density, and extremely long lifetime [1]. Energy will be stored through the electrostatic accumulation of charges in electrical double layer capacitors (EDLCs) made of carbon materials [2]. Supercapacitors' simplicity manufacture and low price enable them to fulfil rising energy demands while maintaining the durability of renewable energy sources [3]. Carbon materials have long been the suitable materials in energy storage due to their superior electrical conductivity, easy fabrication, physical and chemical sustainability, and high surface area among several supercapacitor electrode materials [4].Carbon fibers are fibrous carbonaceous materials having a diameter of 5-10m. Carbon fibers are filaments, lines, or reels that contain more than 92 percent carbon and are normally in a non-graphitic condition, according to the International Union of Pure and Applied Chemistry (IUPAC) [5]. This means that carbon is defined as a two-dimensional long-range arrangement of carbon atoms in planar hexagonal networks with no crystalline structure in the third direction except for some parallel stacking [6]. Carbon fiber (CF), also known as graphite fiber, is a lightweight, durable, and flexible material that can be utilized for both structural and non-structural purposes (e.g., thermal insulation). Most carbon materials demonstrate excellent stability and high-power density when used as supercapacitor electrodes; nevertheless, their specific capacitance and energy density are relatively low, which cannot meet the high energy requirements for practical applications [7]. In this case, carbon materials with a high specific surface area, a reasonable pore size distribution, and desired nanostructure are critically demanded [8]. Carbon fiber, a newly developed synthetic material that is commonly utilized in the production of advanced composites has a wide range of applications in the automotive, aerospace, and electronics industries [9]. Pitch, obtained from petroleum or coal, and polyacrylonitrile have been the most popular types of precursor materials used to make carbon fiber commercially since the 1960s. PAN (polyacrylonitrile) is used as a precursor in about 80% of commercial carbon fiber. PAN is a petroleum-based linear polymer.

Linear PAN comprises polar nitrile groups, due to strong intermolecular interactions and high mechanical characteristics in carbon fibers. Carbon fiber made from PAN, on the other hand, is expensive, thus its use is confined to high-performance structural components [10]. For example, due to their outstanding mechanical properties and high production, CFs based on PAN precursor are the most important in the market [11]. However, as fossil energy is rapidly exhausted, not only will the cost of CFs based on non-renewable energy rise, but environmental pollution from the production of toxic gases (e.g., hydrogen cyanide) using PAN as a precursor will also rise [12]. As a result, developing a process for producing low-cost CFs based on renewable, non-toxic, and sustainable resources is both urgent and practical in the context of climate change mitigation and adaptation. Because of the advantages of renewable and low-cost properties, bio-mass resources such as cellulose, lignin, and wood are attractive precursors for the preparation of CFs [13]. The use of biomass resources for a variety of electrode materials demonstrates that a significant portion of the complex functionalities of living systems are based on complex hierarchical organization from the manometer to the macroscopic scale, which motivates scientists and engineers to develop these novel materials [14]. Because of their abundant availability and added value gained from their renewable and biodegradable nature, biomass sources are becoming increasingly essential.

Conclusion

Jute fiber is a suitable raw material for the preparation of activated or non-activated carbon using a variety of techniques, such as pyrolysis with or without chemical and physical activations. Jute fiber contains cellulose, hemicelluloses, lignin, and a small amount of ash. Due to its capacitance, filtering, and electrical properties, carbon generated from jute can be employed in a variety of applications including energy storage, water treatment, and sensing. It also has a thin, porous structure and a large specific surface area. This paper reviews recent developments in the study of jute fiber and related materials, such as fiber-reinforced polymer composites, and critically evaluates their potential for future product diversification. The jute fiber, yarn, or fabric has a wide range of microstructural and mechanical changes because it is a natural material. It is obvious that jute has uses beyond its original use as a woven wrapping material. Overall, jute fiber has the potential to replace environmentally harmful man-made fiber (such as glass fiber), and in the near future, a variety of high-value applications of jute fiber and its derivative nanomaterials are anticipated to grow significantly in the fields of biodegradable packaging, fashion, electronics, medicine, and energy. Perhaps, jute will regain its glory by snatching up new markets with the offerings of chic and environmentally beneficial items for the burgeoning number of eco-aware consumers.

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