From Crown to Current Year III: Engineering Cellulosic Fiber-Based Battery Cells - A Safe and Scalable Alternative to Lithium Technology

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Steadfast technological advancements have driven notable growth in the demand for efficient and affordable power sources, with production of the lithium-ion battery surging nearly 700% in the past 10 years. Unfortunately, the lithium-ion presents numerous detrimental effects which make its widespread usage concerning. From the release of hazardous chemicals to the use of expensive metals, lithium batteries are often rendered unsustainable and dangerous. This study focuses on producing a safe and scalable battery composition through the utilization of cellulosic waste materials, biochemical reactions between naturally-occurring cofactors and plant flavonoids, and a customized biopolymer structural system. Cellulosic material extracted from the pineapple crown leaf was implemented into the electrodes, coating, and supports as a biodegradable binding agent. Two metabolic supplements, riboflavin and quercetin, were employed to facilitate a reversible redox reaction alongside graphene for enhanced conductivity. To promote longevity and durability, a protective biopolymer coating was fabricated from cellulosic waste material. Noteworthy cell compositions produced statistically comparable electrochemical performance to the lithium composition, possess one-third the weight of the Li-ion, and are three times less expensive to manufacture. Furthermore, the electrode formulations within these cells demonstrate efficient redox activity through cyclic voltammetry, while EIS and galvanostatic testing depict promising interfacial relationships. With further development to minimize premature oxidation during the manufacturing process, this composition displays the potential to serve as an economical and biodegradable alternative to the traditional lithium battery composition.

Awards Won:
Second Award of $2,000