Engineering an Inexpensive and Sustainable Cellulose Battery Cell

Puza, Madelyn (School: College Park High School)
Mundra, Shivani (School: College Park High School)

This study utilized cellulosic fibers derived from organic waste materials to synthesize a biodegradable and inexpensive alternative to the traditional lithium ion battery. Recent developments in electric cars and similar consumer electronics have generated significant concerns regarding environmental sustainability in coming decades, specifically as batteries continue to provide a convenient power source for most of these applications.The most widely used battery, the lithium-ion, or Li-ion, generates multiple challenges throughout its lifespan due to its high production costs and the leaching of toxic chemicals, such as mercury. This study attempts to integrate biodegradable and abundant organic waste cellulosic fibers as the structural component of the electrodes, thus eliminating the use of traditional metals in the electrode. To assemble the electrode cells, raw cellulosic fibers were first extracted from organic waste sources and combined with activated carbon produced from coconut husk. The resulting colloidal solution was then filtered to remove excess water and dried until reaching a solid film. Results indicate that the electrode composition prototypes utilizing banana peel cellulosic fibers and activated carbon derived from coconut husks produced statistically comparable voltage, amperage, and milliwatt production to that of the traditional 1.5 V lithium ion. When assembled with paper separators and a vinegar-based electrolyte, the resulting cell composition generated a voltage averaging 1.72 V, and an amperage averaging 18 mA. With further development, this cell composition could potentially be implemented into many of the same applications as the 1.5 V lithium-ion battery as an economical and biodegradable alternative.

Awards Won:

Central Intelligence Agency: First Award: $1000 award