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Opinion Article

Self-Charging Functionality of the Supercapacitors

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DESCRIPTION

Textile/textile-based wearable electronics have been commercialized in recent years due to their high-tech features, handy size, and light weight. However, most of these portable devices can only be charged an external electrical connection. This feature has raised concerns when implementing handheld devices in advanced applications that require standalone devices. Despite the need for self- charging functionality, there have been limitations to implement self-charging functionality in portable devices built directly on board due to their reliance on an external power source. In contrast, building wearable from building-block fibers, a bottom-up device manufacturing process, offers an ideal solution to enable various functions, especially self-charging capabilities, for advanced applications such as biomedical devices. However, to date, bottom-up approaches face some challenges due to their incompatibility with traditional methods and limited scalability at building-block scale. Introduce a viable route to achieve self-charging capability in the building-block fibers in a template-free and scalable manner. A fiber-based hybrid energy device composed of a supercapacitor and a triboelectric layer exhibits improved electrochemical and spontaneous self-charging behavior. This is attributed to the double effect of high plasma energy on both functional layers.

Over the last few decades, the electronics paradigm has shifted from bulky, stationary devices to lightweight, portable ones for a past few decades; such has from 100 tons of Electronic Numerical Integrator and Computer (ENIAC) to laptop of 1 kg. Even wearable electronics, once considered sci-fi products, are commonplace, as seen in smart watches and smart glasses. Many of these devices can be charged from an external power source, but reliance on external power sources raises concerns about the reliability of portable devices for applications such as biomedical applications. Therefore, advanced portable devices must be self-sufficient to cope with unexpected malfunctions and battery discharge. Energy harvesting has emerged as a promising technology to support power delivery and ultimately enable self-powered electronics. With the advent of wearable electronics, textile-based energy harvesting technology has attracted a great deal of interest from academia and industry. The strong demand for this technology has led to significant advances in fiber-based energy generation through various strategies such as use of composite materials, new device structures, and new manufacturing processes. Despite significant advances, self-charging functionality could not be incorporated into textile mass foam due to the lack of device controllability when building devices directly on textile mass foam.

CONCLUSION

The advanced features for wearable sustainability and reliability, it is preferable to implement a bottom-up approach. In other words, wearable electronics are made from functionalized building blocks to the bulk fiber platform. However, bottom-up approaches are generally not scalable and face several challenges arising from the incompatibility of established conventional methods with fibers. This is due to the different properties of the fibers from bulk fiber morphologies that offer only limited potential approaches for use in wearables. For example, patterning of triboelectrically active layers or electrodes has exposed significant improvement in device performance, but this patterning method is based on a mold template that involves complex photolithographic processes with limited applicability. Other template-free methods have been employed to solve this problem, but many of the newly proposed methods were still limited to bulk textiles and electrodes. A similar self-charging scheme with excellent device performance was presented in a previous report, but the use of Polyvinylidene Fluoride (PVDF) based terpolymers is not suitable due to their irreversible F–P transition behavior and low temperature. In addition, it may limit potential applications to wearables. As a result of these limitations, wearables with advanced functionality are underdeveloped and, therefore, there is an urgent need to develop new technological methods that enable bottom-up construction of wearables direct building-block fibers.

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