Textile-Based Energy Storage Devices
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Wearable supercapacitor textiles are supercapacitors that make use of and/or shaped into textile fibers, yarns, and fabrics, which are inevitable energy storage devices for wearable electronic applications. To date, the major challenge in the development of wearable supercapacitors is how to improve the electrochemical properties of the device while acquiring high flexibility and durability under wearing conditions. Recently, our laboratory has developed several supercapacitor yarns and fabrics, which show record-high electrochemical performances of their kinds as well as excellent flexibility. These textile-based devices can be readily integrated into different textile forms by means of weaving, embroidery, and heat pressing for wearable applications.

Deformable Ag-Coil/Ferrite Wireless Power Transfer (WPT) Module Fabricated by a Printing Technology
Murali Bissannagari and Jihoon Kim (Kongju Nat’l Univ., Korea)

Inkjet-printed NiZn-ferrite films were detached from rigid substrate after annealing at elevated temperatures with an aid of a sacrificial layer. A sacrificial layer was prepared onto the rigid substrate in order to minimize a intermixing at the interface between the inkjet-printed NiZn-ferrite film and the rigid substrate. The detached NiZn-ferrite films were embedded into flexible substrates such as polydimethylsiloxane (PDMS) or polyimide (PI). Structural and Magnetic properties of the embedded NiZn-ferrite films were investigated by various characterization techniques such as X-ray diffraction, Field-emission SEM, vibrating sample magnetometer (VSM), and impedance analyzer. In order to apply the embedded NiZn-ferrite films to wireless power transfer (WPT), Ag spiral inductor coil pattern was printed on the detached NiZn-ferrite film by inkjet printing before the embedding process. Flexibility of the embedded coil/NiZn-ferrite structure was investigated by a bending test. The crack propagation during the bending test was monitored by the change in the resistance of the inductor coil. The WPT performance was demonstrated by applying the embedded coil/NiZn-ferrite structure as a power receiving unit (Rx) with a commercial power transmitting unit (Tx). A series of LED lights were successfully turned on by the wireless power received by the flexible Rx unit.
High-Performance, Ultra-Flexible and Transparent Embedded Metallic Mesh Electrodes for Solid-State Supercapacitors

Jian-Long Xu (Soochow Univ., China)

In this talk, I will introduce our recent works about high-performance, ultra-flexible and transparent embedded metallic mesh electrodes and thus fabricating flexible transparent supercapacitors. We propose a novel approach via selective electrodeposition process combined with inverted film-processing methods for the first time to fabricate large-scale embedded metallic mesh TCEs with excellent optoelectronic properties ($R_s \sim 0.2 \ \Omega/sq$ & $T \sim 91.3\%$), high Figure of Merit ($FOM \sim 1.0 \times 10^4$) and mechanical durability, arising from embedded inverted T-type shape of electrodeposited Ni mesh. The resultant embedded Ni mesh/poly (3,4-ethylenedioxythiophene): poly (styrenesulfonate) hybrid electrodes are utilized both as current collectors and active electrode materials for supercapacitors, which show high transparency ($\sim 83\%$), superior electrochemical performances, excellent mechanical flexibility and high capacitance retention. Moreover, embedded Ag grid TCE is fabricated with a facile soft ultraviolet imprinting lithography method combined with scrap techniques, based on which high-performance flexible transparent supercapacitors are also constructed and obtained.

Large-Area, Stretchable and Transparent Heaters Using Metal Nanofibers with Wireless Operations

Jiuk Jang, Byung Gwan Hyun, Sangyoon Ji, Eunjin Cho, and Jang-Ung Park (UNIST, Korea)

The rapidly-emerging interest in wearable electronics has engendered the need for the development of stretchable and transparent heating films to replace the conventional heaters. Although indium tin oxide (ITO) has been used as the heater, it has mechanical limitations due to its intrinsic fragility. Here, we demonstrate a stretchable, transparent and large-area resistive heater on various substrates using the ultra-long Ag nanofibers (AgNFs). Optical transmittance and the sheet resistance of electrode can be controlled by adjusting area fraction of AgNF random networks; therefore, various temperature range can be achieved depending on the purpose. The heater presents high temperature (250 °C) at a low operating voltage (5 V, Fig. 1.) and excellent temperature reliability under large strain (40%). Furthermore, we demonstrate the wireless operation of the heating film for fine control of its temperature using smart devices via Bluetooth.