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Zinc Oxide Nanorods Decorated Nanofibers Based Flexible Electrodes for Capacitive Energy Storage Applications

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Abstract : In recent times, flexible supercapacitors retaining high electrochemical performance and steadiness along with mechanical endurance has developed as a spring of attraction due to the exponential progress and innovations in energy storage devices. To meet the rampant increasing demand of energy storage device with the small form factor, a unique, low cost and high-performance supercapacitor with considerably higher capacitance and mechanical robustness is required to recognize their real-life applications. Here in this report, synthesis route of electrode materials with low rigidity and high charge storage performance is reported using 1D-1D hybrid structure of zinc oxide (ZnO) nanorods, and conductive polymer smeared polyvinylidene fluoride–trifluoroethylene (P(VDF–TrFE)) electrospun nanofibers. The ZnO nanorods were uniformly grown on poly (3,4-ethylenedioxythiophene) polystyrene sulfonate (PEDOT: PSS) coated P(VDF-TrFE) nanofibers using hydrothermal growth to manufacture light weight, permeable electrodes for supercapacitor. The PEDOT: PSS coated P(VDF-TrFE) porous web of nanofibers act as framework with high surface area. The incorporation of ZnO nanorods further boost the specific capacitance by 59%. The symmetric device using the fabricated 1D-1D hybrid electrodes reveals fairly high areal capacitance of 1.22mF/cm^2 at a current density of 0.1 mA/cm^2 with a power density of more than 1600 W/Kg. Moreover, the fabricated electrodes show exceptional flexibility and high endurance with 90% and 76% specific capacitance retention after 1000 and 5000 cycles respectively signifying the astonishing mechanical durability and long-term stability. All the properties exhibited by the fabricated electrode make it convenient for making flexible energy storage devices with the low form factor.

Keywords : ZnO nanorods, electrospinning, mechanical endurance, flexible supercapacitor
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