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Electrospun nanofiber membranes as ultrathin flexible supercapacitors

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A highly flexible electrochemical supercapacitor electrode was developed with a novel metal oxide-reinforced nanofiber electrode by utilizing a solution-based electrospinning technique. The facile fabrication steps involved the introduction of metal precursors into a polymeric solution, which was subjected to an *in situ* electrospinning process. The electrospun polymeric web with metallic ingredients was then subjected to an oxidative stabilization process that induced the formation of metal oxide nanoparticles within the polymer structure. Finally, the metal oxide nanoparticles incorporated with nanofibers were obtained using a carbonization process, thus converting the polymer backbones into a carbon-rich conductive nanofiber structure. The fabricated nanofibers were decorated and implanted with metal oxide nanoparticles that had a surface-decorated structure morphology due to the solubility of the precursors in the reaction solution. The electrochemical performance of the fabricated metal oxide reinforced with nanofiber electrodes was investigated as an electrochemical system, and the novel morphology significantly improved the specific capacitance compared to a pristine carbon nanofiber membrane. As a result of the uniform dispersion of metal oxide nanoparticles throughout the surface of the nanofibers, the overall capacitive behavior of the membrane was enhanced. Furthermore, a fabricated free-standing flexible device that utilized the optimized nanofiber electrode demonstrated high stability even after it was subjected to various bending operations and curvatures. These promising results showed the potential applications of these lightweight, conductive nanofiber electrodes in flexible and versatile electronic devices.

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