Cost-effective and Eco-friendly MnO_2 based 2.2 V High Energy Aqueous Supercapacitor

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Aqueous supercapacitors with enhanced energy densities are much needed for their non-toxic and environmental benignity. Metal oxide based pseudocapacitors enhance the specific capacitance and energy density of the device by enlarging the potential window of aqueous electrolyte beyond 1.0 V along with faradic participation. To capture this advantage, MnO_2 nanosheets are synthesized by eco-friendly electrodeposition technique. The charge storage capability of MnO_2 in 0.5 M Na_2SO_4 could be extended to 1.20 V *vs.* Ag/AgCl, thus becoming the best positive electrode for asymmetric supercapacitors (ASCs). The effect of potassium iodide (KI) redox additive to the electrolyte in improving the energy density and device performance is analyzed with varying concentrations. ASC designed with YP-50 carbon and MnO_2 as negative and positive electrodes in optimized KI concentration with 2.2 V electrochemical window resulted in superior specific capacitance of 134 F g^{-1} and capacity retention of 83 % for 10000 cycles with a high energy density of 90 Wh kg^{-1} owing to the dual pseudocapacitance of active material and electrolyte. The work further provides an understanding of MnO_2 charge storage properties beyond the most reported 0-0.8/ 0-1.0 V potential window and redox mediator's role in boosting overall device performance in aqueous ASC's.