ScienceDirect

Journal of Physics and Chemistry of Solids
Volume 141, June 2020, 109425

Enhanced energy density of flexible asymmetric solid state supercapacitor device fabricated with amorphous thin film electrode materials

Dhanaji B. Malavekar [a], Vaibhav C. Lokhande [b], Vikas J. Mane [a], Shivaji B. Ubale [a], Umakant M. Patil [a], Chandrakant D. Lokhande [a]

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https://doi.org/10.1016/j.jpcs.2020.109425
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Abstract

Supercapacitors have recently received immense interest in scientific community, as a complementary technology to batteries, to meet the various requirements for energy usage in practice. Amorphous MnO_2 and CuS thin films are prepared on stainless steel-304 (SS) substrate by chemical bath deposition (CBD) and successive ionic layer adsorption and reaction (SILAR) methods, respectively. Asymmetric flexible solid state supercapacitor fabricated with configuration of SS/A-MnO_2/Polyvinyl acetate (PVA)-Na_2SO_4/A-CuS/SS delivered an impressive specific energy of 57.4Wh kg^{-1} at specific power 317Wkg^{-1} and excellent cycling stability over 10,000 cycles with capacitive retention of 84%. Moreover, series configuration of two asymmetric devices shows the capability of powering 211 red LEDs for ~150s after charging for 30s.

Graphical abstract

(A) FE-SEM of amorphous MnO_2, (B) The XRD graphs of Amorphous MnO_2 and CuS, (C) Comparision of energy density and power density of SS/A-CuS/Polyvinyl acetate (PVA)-Na_2SO_4/A-MnO_2/SS (D) Assembly of 5×5cm^2 SS/A-CuS/Polyvinyl acetate (PVA)-Na_2SO_4/A-MnO_2/SS solid state flexible asymmetric supercapacitor device with amorphous MnO_2 as an anode and amorphous CuS as a cathode, and (E) FE-SEM of amorphous CuS, and (F) Stability graph of supercapacitor device.