Controllable metal–organic framework-derived Nico-layered double hydroxide nanosheets on vertical Graphene as mott–schottky heterostructure for highperformance hybrid supercapacitor

ABSTRACT

Layered double hydroxide (LDH) is considered a highly promising electrode material for supercapacitors (SCs) due to its high theoretical specific capacitance. However, LDH powders often suffer from poor electrical conductivity, structure pulverization, slow charge transport, and insufficient active sites. Herein, a selfsupporting electrode with a Mott–Schottky heterostructure has been designed for high-performance SCs. The electrode consists of low crystallinity NiCo-LDH nanosheets and vertical graphene (VG) directly grown on carbon cloth. The LDH was converted from a metal–organic framework (MOF) by the sol–gel method. This self-supporting electrode provides fast charge transfer, reducing the pulverization effect and energy barrier. The Mott–Schottky heterostructure of LDH@VG regulates electron density and enhances electron transfer, as confirmed by density functional theory calculation. The optimized LDH@VG heterostructure electrode exhibits an excellent areal capacitance of 5513.8 mF cm 2 and rate capability of 82.1%. Furthermore, the fabricated hybrid SC demonstrates excellent energy density of 404.8 μWh cm 2 at 1.6 mW cm 2 and a remarkable cycling life, with a capacitance of 92.0% after 10 000 cycles. This work not only provides a simple dip-coating and MOF conversion method to synthesize heterojunction-based electrodes, but also broadens the horizon for designing advanced electrode materials for SCs.