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Nickel cobaltite nanoflakes grown around nickel foam-supported expanded mesocarbon microbeads for battery-like electrochemical capacitors

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Abstract

The eMCMBs (expanded mesocarbon microbeads) composed of fluffy graphene oxide nanosheets were obtained by chemical oxidation of MCMB graphite powder. The eMCMBs were attached to the skeleton of nickel foam through electrophoretic deposition. After heat treatment in reducing atmosphere, the eMCMBs were converted into reduced eMCMBs (reMCMBs) composed of sponge-like graphene nanosheets. Nickel foam with attached reMCMBs was used as a highly conductive scaffold to support nickel cobaltite nanoflakes. The sponge-like reMCMBs accommodated electrolyte solution, afforded current collector, and functioned as a stress buffer to alleviate electrode damage. Macroporous nickel cobaltite film with mesoporous thin nanoflakes could provide large amounts of pores for easy penetration of electrolyte solution, huge interfacial area for facile redox reactions, and short transport distance for ions and electrons. Nickel cobaltite grown around nickel foam with attached reMCMBs could deliver a high specific capacitance of 1025 F g^{-1} at 5 A g^{-1}, greater than that grown around nickel foam (688 F g^{-1}). Nickel cobaltite nanoflakes grown on reMCMBs turned out to decrease the kinetic resistance, diffusive impedance, and volumetric strain, resulting in better capacitance, rate capability, and electrochemical stability.

Keywords: Nickel cobaltite; Expanded graphite; Energy storage; Nickel foam; Electrochemical capacitors.

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