

COBALT-IRON LDH/rGO NANOHYBRID ELECTRODES FOR ENHANCED ENERGY STORAGE IN HYBRID SUPERCAPACITORS

Janhavi Sharma¹, Prasad Eknath Lokhande¹, Amrita Jain^{1*}

¹Institute of Fundamental Technological Research, Polish Academy of Sciences, Pawińskiego 5B, 02-106
Warsaw, Poland

Email: jsharma@ippt.pan.pl

Transition-metal layered double hydroxides (LDHs), a class of inorganic polymetallic clays, have emerged as promising electrode materials for electrochemical energy storage. Their layered structure, compositional flexibility, high charge storage capacity, low internal resistance, abundance of redox-active sites, and strong electrochemical stability make them attractive for this application. However, their performance is often limited by poor intrinsic electrical conductivity and particle agglomeration, which reduce rate capability and cause cycling capacitance loss. To address these challenges, we synthesized a cobalt-iron layered double hydroxide integrated with reduced graphene oxide (CoFe LDH/rGO) using a simple hydrothermal method.

Structural and morphological analyses confirmed the successful formation of a well-dispersed CoFe LDH/rGO nanohybrid with a porous architecture that facilitates electrolyte penetration and charge transport. The addition of reduced graphene oxide created a conductive network, improving electron mobility and preventing LDH nanosheet aggregation. Electrochemical studies showed enhanced charge storage, excellent rate capability, and stable cycling performance, demonstrating the synergistic benefits of combining these materials.

To assess practical applicability, we assembled a hybrid supercapacitor using the CoFe LDH/rGO nanohybrid as the positive electrode and activated carbon as the negative electrode in a gel-polymer electrolyte. The device demonstrated strong energy-storage performance and long-term electrochemical stability. This improvement results from rapid electron transport through the graphene framework, efficient ion diffusion in the porous structure, and greater utilization of electrochemically active sites. These results indicate that CoFe LDH/rGO nanohybrids are a promising approach for next-generation high-performance hybrid supercapacitors.