

Asymmetric Supercapacitors using Hybrid Bi and Ni-based Materials

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Demand for efficient, economic, and eco-friendly energy storage has grown dramatically in recent years for applications in electronic appliances, electric vehicles, and a smart and sustainable energy grid. Electrical double layer capacitors (EDLCs) and lithium-ion batteries can respectively provide high power-density and high energy-density electrical energy storage. Low-cost, solution-processed electrode materials have attracted significant research interest for their green and economical applications in such energy harvesting and storage devices. Bismuth chalcogenides, halides and chalcogenides have captured research interests for their multiple functionalities in photocatalysis, photovoltaics, and radiation detection, however applications in electrical energy storage remain mainly focused on Bi₂O₃ and Bi₂S₃. Here, we demonstrate ambient-pressure and moderate-temperature synthetic routes to nanocrystals and films of bismuth chalcogenides and halides, including Bi₁₃S₁₈I₂ [1,2], BiSI [2], BiSI-reduced-graphene-oxide [3] and [Organic-cation][BiI₄] [4]. We demonstrate their potential as anode materials in electrical energy storage, including EDLC-type supercapacitors and pseudocapacitors, showing high capacitance/capacity and excellent cycle stability. We have also developed Ni(OH)₂-based cathodes with exceptional charge-storage capacity [5,6], and combine these with the Bi-based anodes to give full devices with excellent energy and power density.

References

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