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FUNCTIONALIZED GRAPHENE AS ENERGY STORAGE SUPERCAPACITOR

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Abstract

Supercapacitor is an energy storage device that store energy via accumulation of electrical charges at the electrode double layer. It received much attention in scientific community due to its high power density (higher than battery and fuel cell) and high energy density (higher than conventional capacitor). Commercial available supercapacitors mostly focus on activated carbon as the electrode material due to its cost efficient and large surface area with good conductivity. The booming of graphene in research community has drawn the attention of supercapacitor manufacturers to look into this Nobel Prize winning nanomaterials, as it possesses superb conductivity and enhanced surface area. Numerous works on the graphene as supercapacitor electrode had been published. However, graphene itself could not store much energy as it solely relies on double layer capacitance. The incorporation of pseudocapacitance material to make the hybrid supercapacitor is a solution to increase the charge storage ability. The synergetic effect of double layer capacitance and pseudocapacitance could provide the enhancement of capacitance whilst maintaining the long term cyclability. In this work, we report a simple co-precipitation method to produce graphene/$Ni_3(Fe(CN)_6)_2$ composite as hydrid supercapacitor electrode. $Ni_3(Fe(CN)_6)_2$ is a good candidate to replace costly ruthenium in enhancing pseudocapacitance. With sonication and co-precipitation, $Ni_3(Fe(CN)_6)_2$ nanoparticles were intercalated between graphene interlayer sheets, as confirmed by microscopic and spectroscopic analysis. The electrode was tested electrochemically and results show that graphene extended the operating voltage of $Ni_3(Fe(CN)_6)_2$ and the specific capacitance was enhanced by $Ni_3(Fe(CN)_6)_2$. The energy density of graphene/$Ni_3(Fe(CN)_6)_2$ was found to be increased by at least 2 folds as compared to $Ni_3(Fe(CN)_6)_2$ alone. The works suggest that the graphene/$Ni_3(Fe(CN)_6)_2$ is a good electrode material for high energy supercapacitor.