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**Construction of three-dimensional nitrogen-doped graphene coated with uniform nickel oxide/nickel ferrite nanoparticles with enhanced electrochemical properties for supercapacitors**

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**Abstract**

In this paper, nickel oxide (NiO) and nickel ferrite (NiFe<sub>2</sub>O<sub>4</sub>) nanoparticles grown on three-dimensional nitrogen-doped graphene (denoted as NiO/NiFe<sub>2</sub>O<sub>4</sub>/3DNG) are successfully synthesized by combining tube furnace calcination method and microwave synthesis method. The electrochemical characteristics of as-prepared composites have been quantitatively measured by cyclic voltammetry (CV), galvanostatic charge-discharge (GCD) measurements and electrochemical impedance spectroscopy (EIS) in different concentration of potassium hydroxide (KOH) electrolyte. The results show that the 3DNG based ternary hybrids possess an ultrahigh specific capacitance of 1556.5 F g<sup>-1</sup> at the current density of 1 A g<sup>-1</sup> in 6 M KOH solution and with a retention of 92.5 % capacitance value over 2000 cycles. Furthermore, the NiO/NiFe<sub>2</sub>O<sub>4</sub>/3DNG hybrids exhibit the maximum energy density of 55.6 Wh kg<sup>-1</sup> with the power density of 1598.7 W kg<sup>-1</sup> in the two-electrode system. This high-performance of as-prepared hybrids can be attributed to the synergistic effect between NiO and NiFe<sub>2</sub>O<sub>4</sub>, as well as the satisfied 3DNG conductive network. In addition, this work might develop a new and effective technique for high-activity, good soft and environmentally friendly substrate materials used in a wide range of applications in supercapacitors.

**Keywords:** nickel ferrite; three dimensional nitrogen-doped graphene (3DNG); supercapacitor; flexible electrode materials.

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