Supporting Information

Fabrication of composite material of Gd_2O_3, Co_3O_4 and graphene on nickel foam for high-stability supercapacitor

Shasha Wang, [a] Shixiang Lu, *[a] Wenguo Xu, *[a] Shuguang Li, [a] Jingjing Meng, [a] and Yulin Xin [a]

[a] School of Chemistry and Chemical Engineering, Beijing Institute of Technology, Beijing 100081, China
* Corresponding author, E-mail: shixianglu@bit.edu.cn (Shixiang Lu); xuwg60@bit.edu.cn (Wenguo Xu)

S1 Preparation of Gd_2O_3/Co_3O_4/NF composite electrode

0.8 mmol (0.232 g) $Co(NO_3)_2{\cdot}6H_2O$, 0.8 mmol (0.361 g) $Gd(NO_3)_3{\cdot}6H_2O$ and 1 mmol (0.060 g) urea were dissolved in 15 mL of deionised water and stirred magnetically for 40 min to form a homogeneous solution. A portion of the above-treated NF and mixed solution was transferred to an autoclave lined with polytetrafluoroethylene and reacted for 12 h in an oven at 180°C. After being washed with ethanol and deionized water, the Gd_2O_3/Co_3O_4 precursor was dried in an oven at 90 °C for 4 h. After 2 h of annealing in a muffle furnace at 300 °C, the Gd_2O_3/Co_3O_4/NF composite electrode was produced.

S2 Preparation of Gd_2O_3/rGO/NF composite electrode

In 7.5 mL of deionized water, 0.8 mmol $Gd(NO_3)_3{\cdot}6H_2O$ (0.361 g) and 1 mmol (0.060 g) urea were dissolved and magnetically agitated for 40 min to generate a homogenous solution. Then, 7.5 mL of homogenous graphene oxide suspension (2 $mg{\cdot}mL^{-1}$) was added. Continue magnetic stirring for 40 min to ensure thorough mixing. The processed NF and combined solution were placed in an autoclave with polytetrafluoroethylene and reacted for 12 h in an oven at 180 °C. The precursor was cleaned with ethanol and deionized water before being dried in a 90 °C oven for 4 h. Finally, the Gd_2O_3/rGO/NF composite electrode was created by annealing it for 2 h in a muffle furnace at 300 °C.

S3 Preparation of Co_3O_4/rGO/NF composite electrode

0.8 mmol (0.232 g) $Co(NO_3)_2{\cdot}6H_2O$ and 1 mmol (0.060 g) urea were diluted in 7.5 mL deionized water and magnetically agitated for 40 min to generate a homogenous solution. Then 7.5 mL of homogenous graphene oxide suspension (2 $mg{\cdot}mL^{-1}$, ultrasonication for 2 h) was added. Continue magnetic stirring for 40 min to thoroughly combine. A portion of the above-mentioned treated NF and the combined solution were placed to an autoclave with polytetrafluoroethylene and reacted in an oven at 180 °C for 12 h. The precursor was rinsed with ethanol and deionized water before being dried in an oven at 90 °C for 4 h. Finally, the Co_3O_4/rGO/NF composite electrode was formed after 2 h of annealing in a muffle furnace at 300 °C.

S4 Preparation of rGO/NF composite electrode

Added 7.5 mL of deionized water and 7.5 mL of graphene oxide suspension (2 $mg{\cdot}mL^{-1}$) to the beaker. Mixed well with magnetic stirring for 40 min. A portion of the above-mentioned treated NF and the combined solution were placed to an autoclave with polytetrafluoroethylene and reacted in an oven at 180 °C for 12 h. The surface of the NF was cleaned with ethanol and deionized water before being dried in a 90 °C oven for 4 h. Finally, the rGO/NF composite electrode was formed after 2 h of annealing in a muffle furnace at 300 °C.

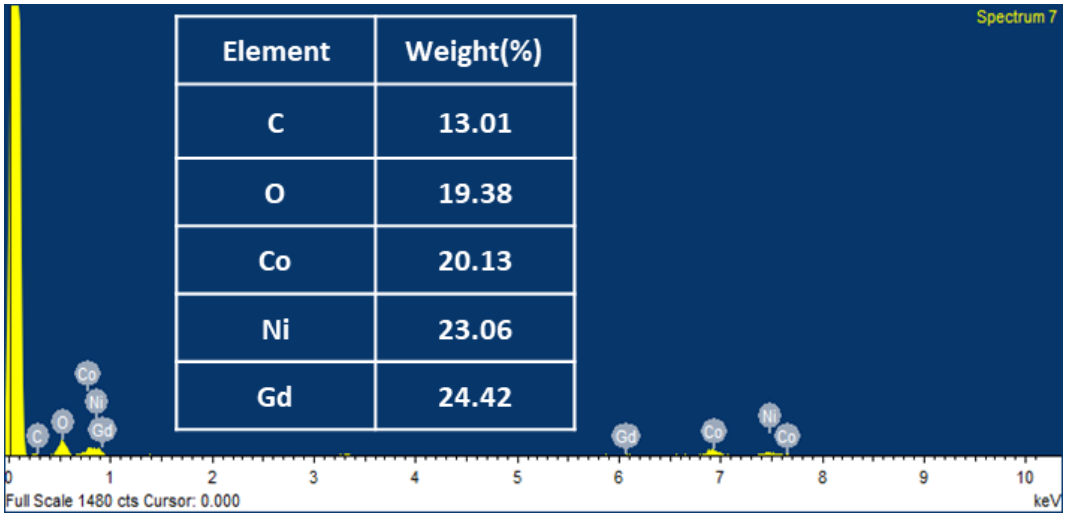

Fig. S5 EDS of Gd_2O_3/Co_3O_4/rGO/NF.

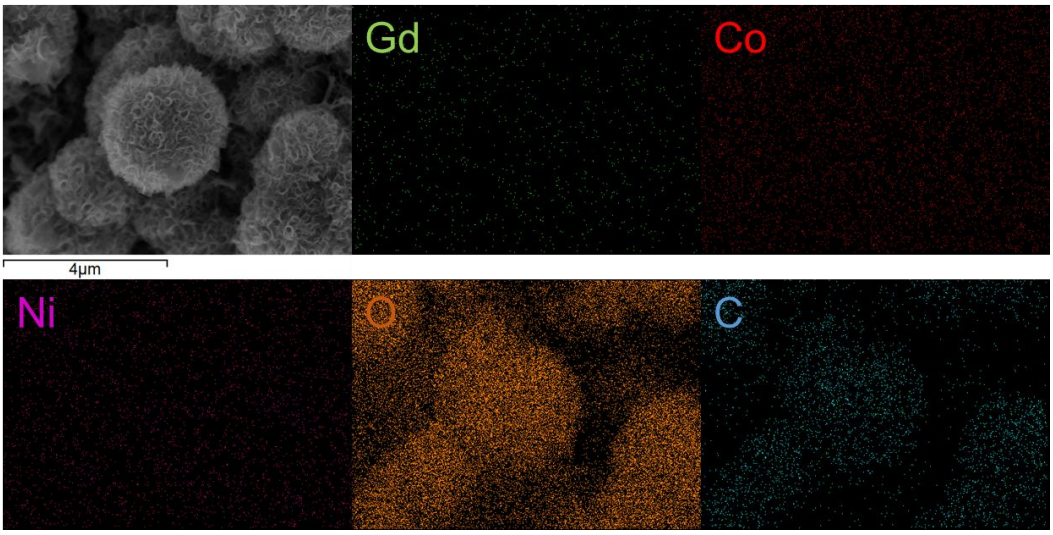

Fig. S6 EDS elemental mapping images of the composite (Gd, Co, Ni, O and C).

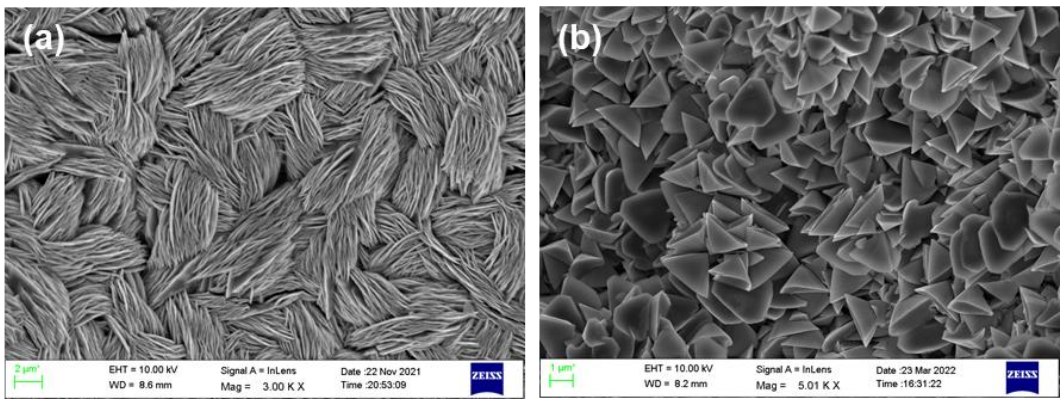

Fig. S7 SEM images of (a) Gd_2O_3/ NF, (b) Co_3O_4/ NF.

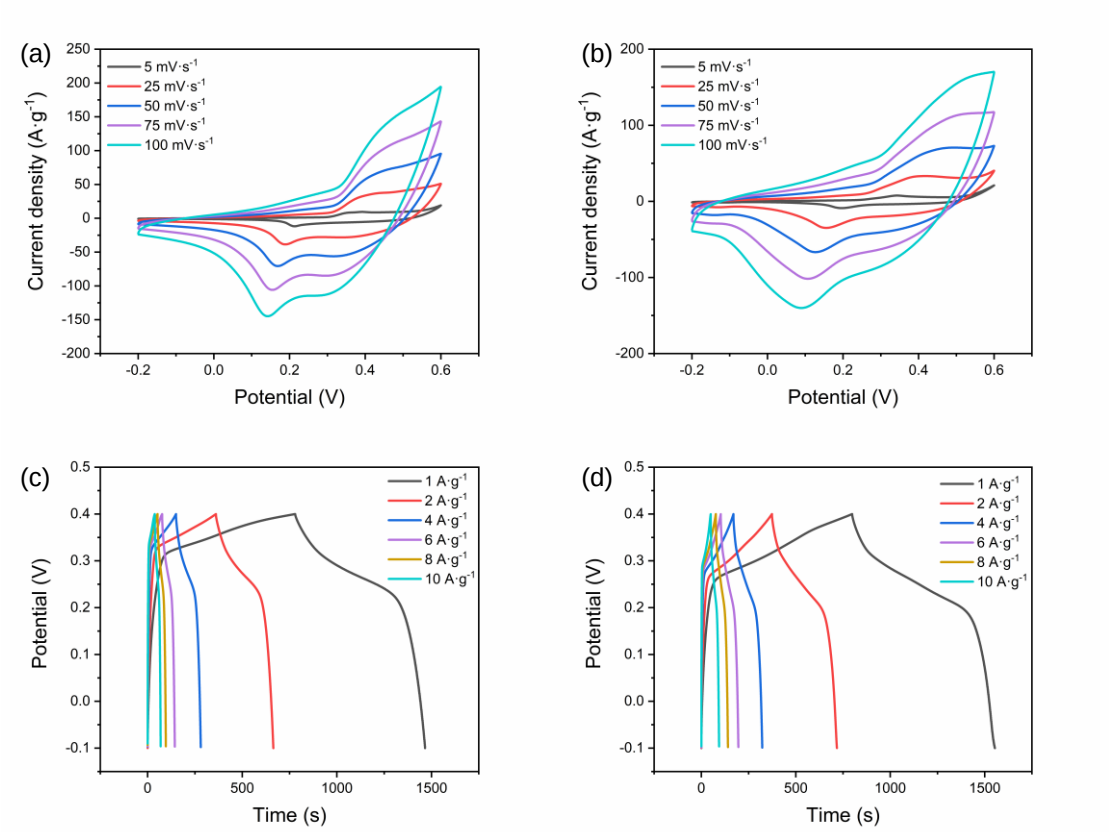

Fig. S8 (a, b) CV curves of Gd_2O_3/rGO/NF and Co_3O_4/rGO/NF electrodes under different scan rates; (c, d) GCD curves of Gd_2O_3/rGO/NF and Co_3O_4/rGO/NF electrodes at different current densities.