Electronic Supporting Information (ESI) for

N and S co-doped graphene enfolded Ni-Co-layered double hydroxides: An excellent electrode material for high-performance energy storage devices

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Experimental details

Purification of graphite flakes

First, 30 mL concentrated HF was taken into a plastic beaker then 2 g graphite was slowly added to it. A homogeneous mixture was prepared via mechanical stirring at room temperature. After 1 h, the graphite flakes were allowed to settle down and the acid was decanted. The graphite flakes were washed thoroughly using a large amount of deionized water (DI water) to achieve pH = 7. Finally, the graphite flakes were dispersed in 20 mL acetone followed by drying in the vacuum oven at 100 °C.

GO synthesis

Modified Hummer's method was used for graphene oxide (GO) synthesis [1,2]. For the oxidation of graphite flakes, 1 g of $NaNO_3$ was mixed properly with the purified graphite flakes (2 g). A concentrated H_2SO_4 was taken into a glass beaker contained in the ice bath. Then the mixture was slowly added to H_2SO_4. Then $KMnO_4$ (6 g) was added under vigorous stirring, and the temperature was retained < 20 °C. After stirring 10 min, the ice bath was replaced with a water bath and the temperature was raised to 35 °C. The mixture was kept under stirring at 35 °C for 24 h. 150 mL of DI water was added to the mixture followed by adding 2.5 mL H_2O_2 and 240 mL DI water to complete the oxidation of graphite. Finally, it was washed with HCl, DI water, and ethanol. Then it will be dried using the vacuum at a temperature of 25 °C.

The oxidized graphite flakes were dispersed in the DI water (2 mg/mL). The exfoliation of GO nanosheets was achieved via 2 h of ultra-sonication.

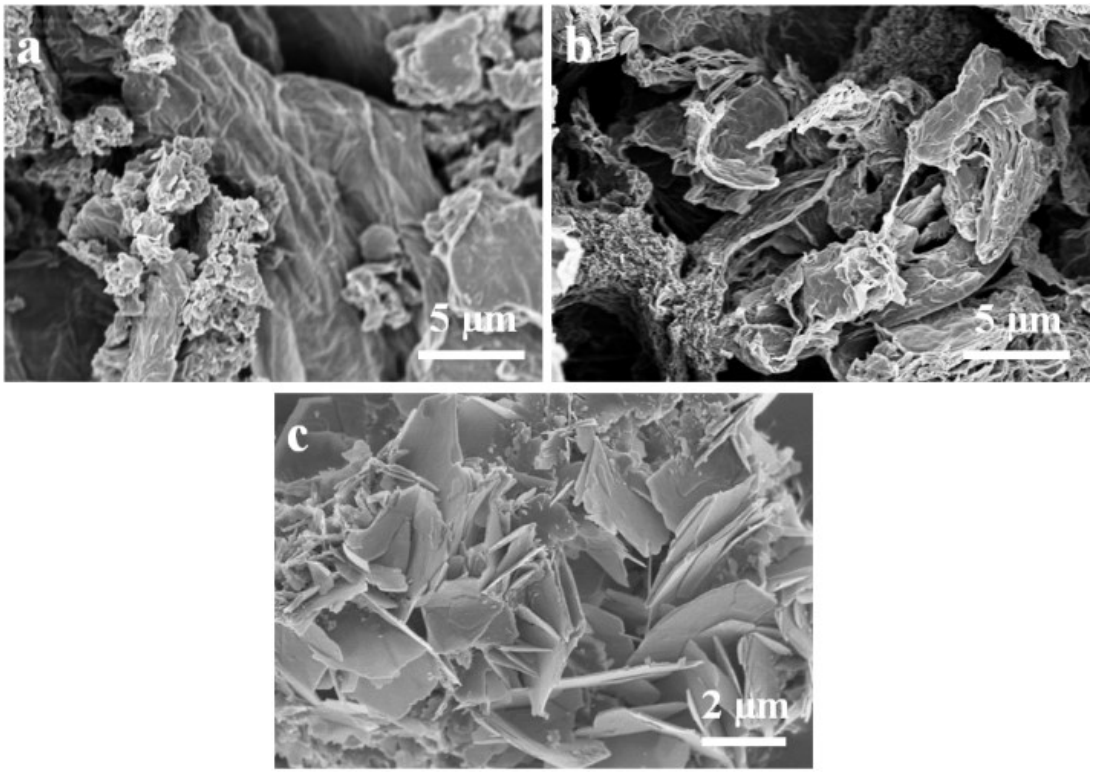

Fig. S1. FE-SEM images of (a) GO, (b) rGO-NS, and (c) Ni-Co-LDH.

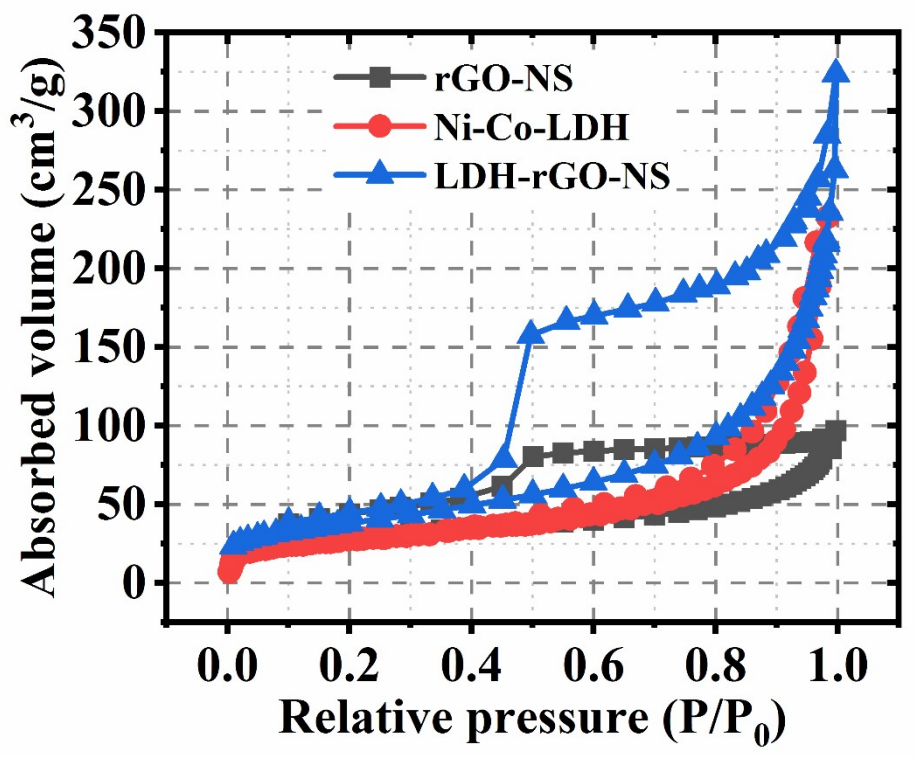

Fig. S2. Nitrogen adsorption–desorption isotherms for rGO-NS, Ni-Co-LDH, and LDH-rGO-NS.

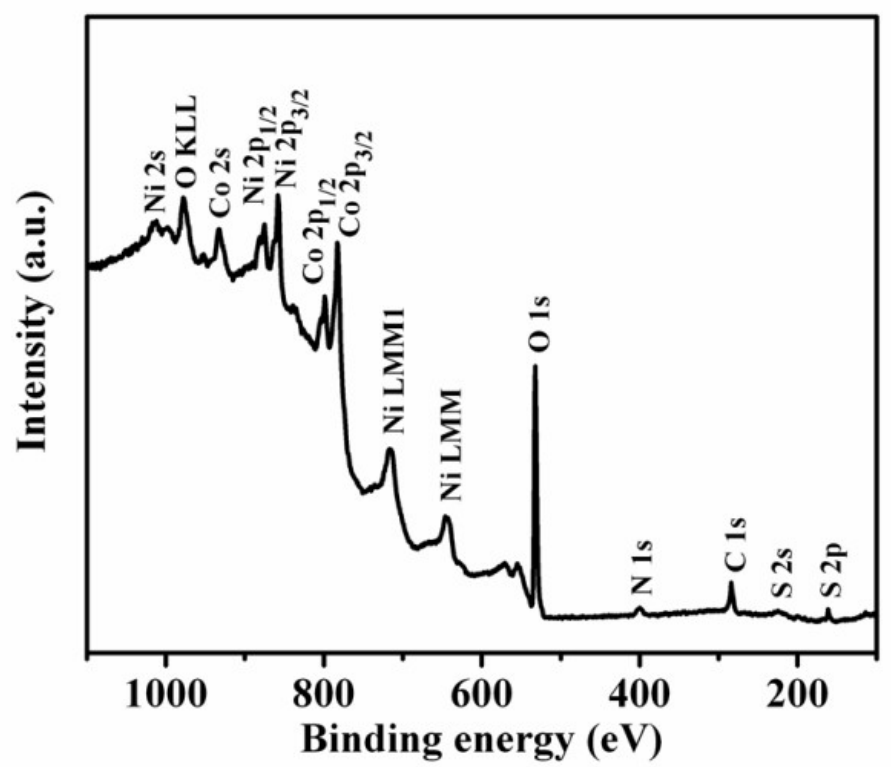

Fig. S3. XPS survey of LDH-rGO-NS, confirming the presence of the C, Ni, Co, O, S, and N elements.

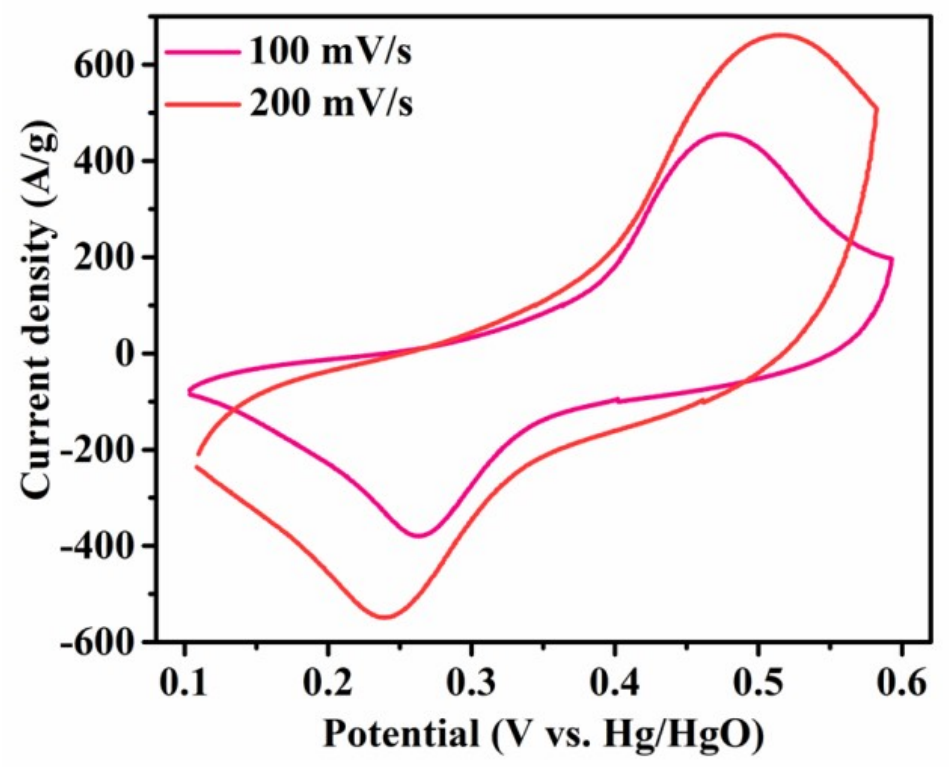

Fig. S4. CV of LDH-rGO-NS electrode at the scan rate of 100 and 200 mV/s.

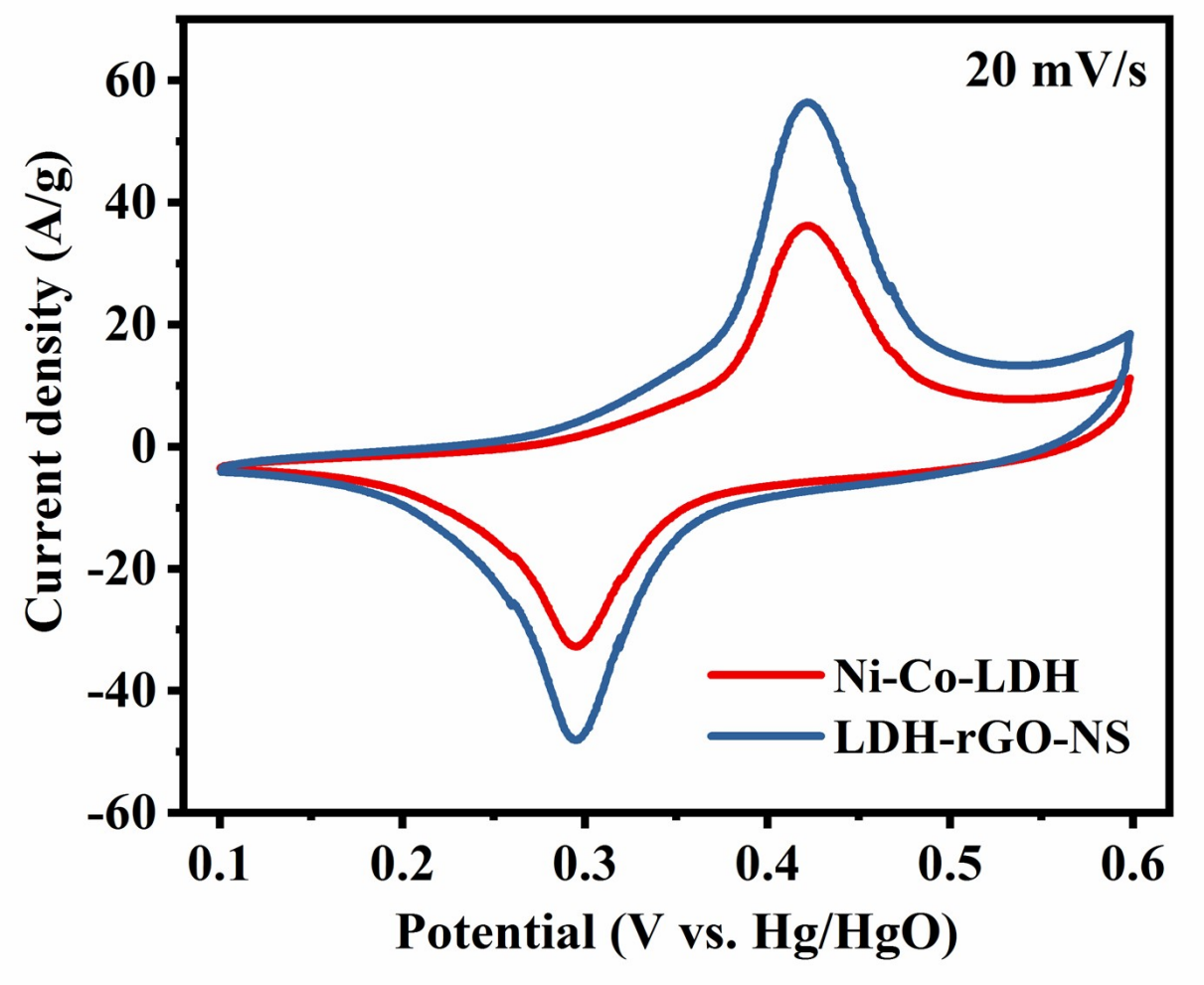

Fig. S5. CV of Ni-Co-LDH and LDH-rGO-NS electrode at the scan rate of 20 mV/s.

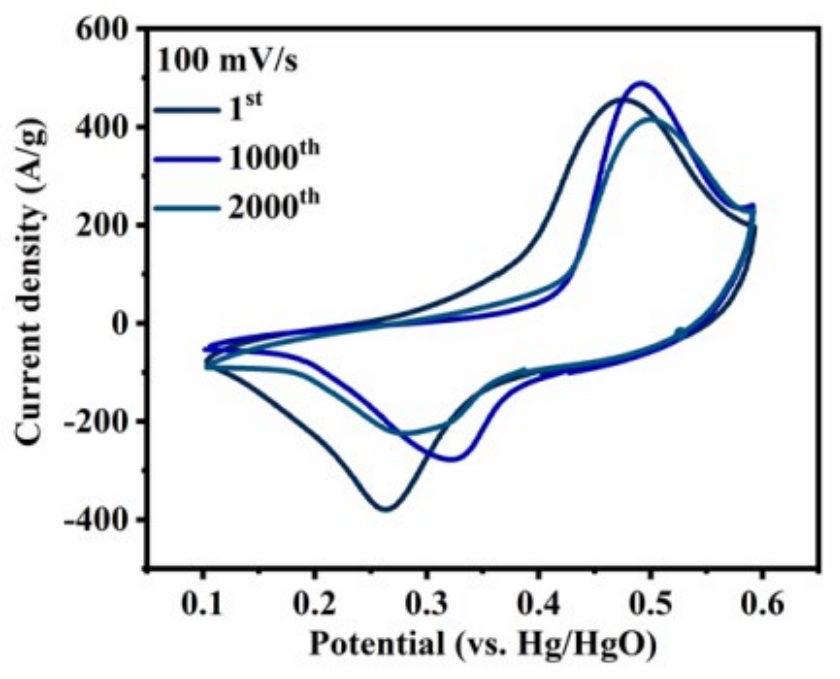

Fig. S6. CV of LDH-rGO-NS electrode for 1st, 1000th and 2000th cycle at a scan rate of 100 mV/s. The obtained retention rate after 2000 cycles is ~71%.

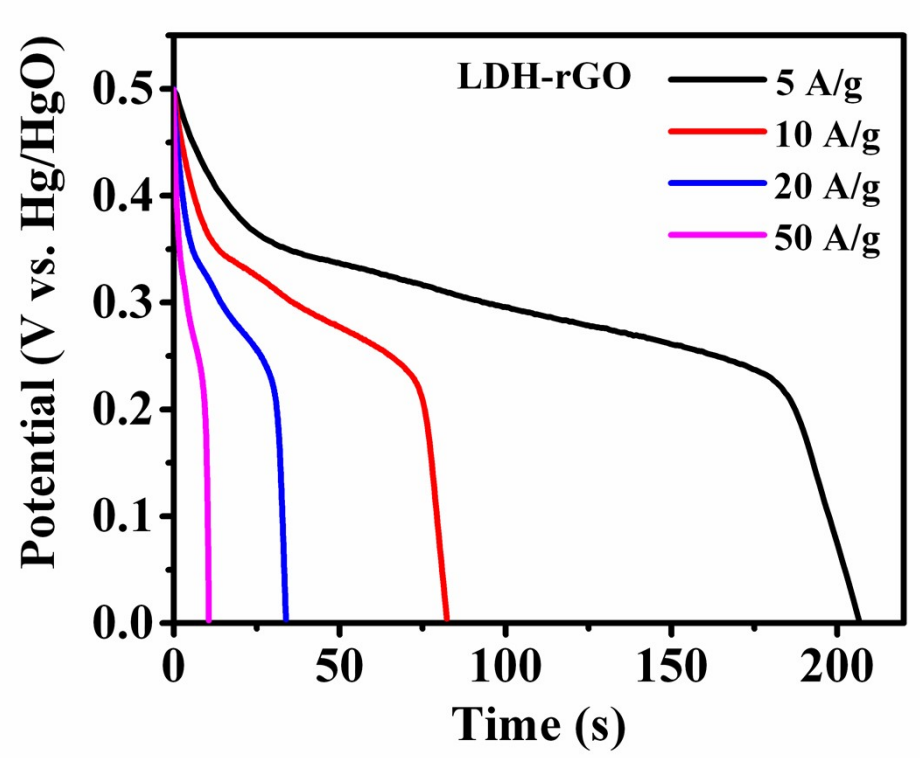

Fig. S7. Specific capacity as a function of discharge current density of LDH-rGO electrode.

References

[1] Hummers WS, Offeman RE. Preparation of Graphitic Oxide. J Am Chem Soc 80 (1958) 1339.

[2] Kovtyukhova NI, Ollivier PJ, Martin BR, Mallouk TE, Chizhik SA, Buzaneva EV, et al. Layer-by-layer assembly of ultrathin composite films from micron-sized graphite oxide sheets and polycations. Chem Mater 11 (1999) 771-778.