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High performances aqueous rechargeable nickel//bismuth batteries with Bi_2MoO_6@rGO and $Co_{0.5}Ni_{0.5}MoO_4$@rGO as electrode materials

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Electrochemical Calculations:

1.Single electrode：

Based on discharge curves, the specific gravimetric capacity of active materials for the single electrode can be calculated according to the following equation (1):

$$C_m = \frac{I}{m} \times \Delta t \qquad (1)$$

Where C_m (mAh/g) means the specific gravimetric capacity, I (A) means the discharge current, m (g) means the mass of active materials in the single electrode, Δt (s) means discharge time.

2. Ni//Bi battery:

The mass of the electrode active materials should be adjusted before assembling Ni//Bi battery so that two electrodes are balanced on the basis of equation (2):

$$C_m^- \times M_- = C_m^+ \times M_+ \qquad (2)$$

Where C_m^- and C_m^+ are the specific capacity of the cathode and anode (mAh/g), M_+ and M_- are the mass of active materials (mg), respectively.

The specific capacity of two-electrode cell model (C_{cell}) can also be calculated depending on software or equation (3):

$$C_{cell} = \frac{I}{m} \times \Delta t \tag{3}$$

Where C_{Cell} (mAh/g) is specific capacity, I (A) is discharge current, Δt (s) is discharging time, and m (g) is total mass of active materials.

The energy density (E) and power density (P) of Ni//Bi battery can be calculated by the following equations (4) and (5):

$$E = \int_{0}^{\Delta t} IV_{(t)}dt \tag{4}$$

$$P = \frac{E}{\Delta t} \tag{5}$$

Where E (Wh/kg) is energy density, I (A/g) is current density, $V(t)$ (V) is discharging voltage and dt is time differential, P (W/kg) is power density, Δt (s) is the discharging time.

The calculation of "b values":

The relationship between peak current (i) and scanning rate (v) obeying the equation (6):

$$i=av^{b} \tag{6}$$

Where a and b are different positive number. When $0.5<b<1$, the electrochemical behavior of electrode active materials is controlled by diffusion-controlled process and surface-capacitive effect. When b=0.5, the electrochemical behavior is controlled by diffusion process. And when b=1, the electrode exhibits surface-capacitive effect.

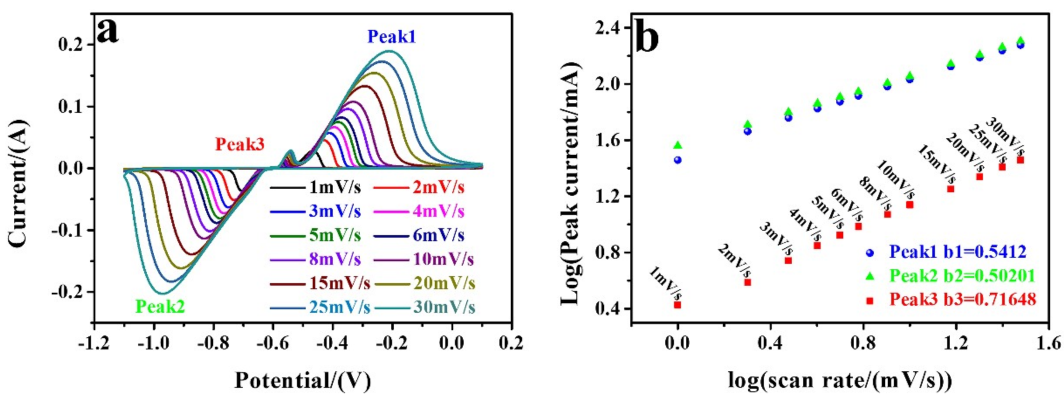

Fig. S1 CV curves of Bi_2MoO_6@rGO-25 (a); The relation between the anodic/cathodic peak current and the scan rate of Bi_2MoO_6@rGO-25 (b)

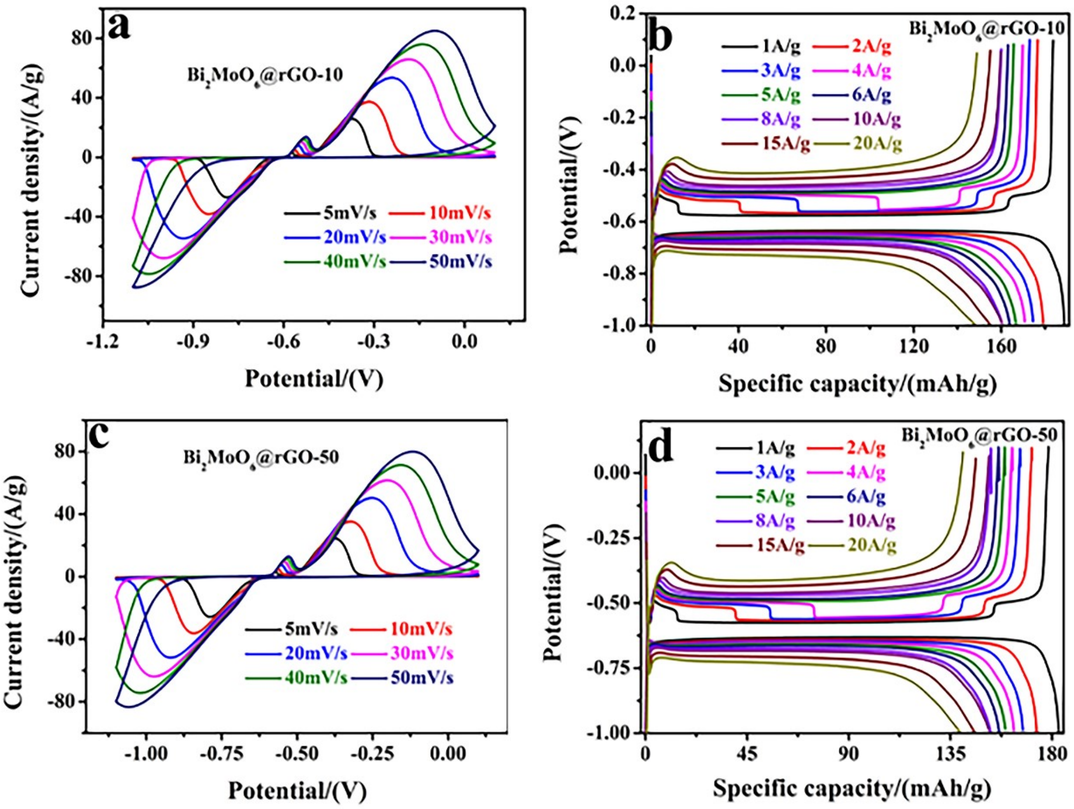

Fig. S2 CV curves of Bi_2MoO_6@rGO-10 (a) and Bi_2MoO_6@rGO-50 (c); GCD curves of Bi_2MoO_6@rGO-10 (b) and Bi_2MoO_6@rGO-50 (d)

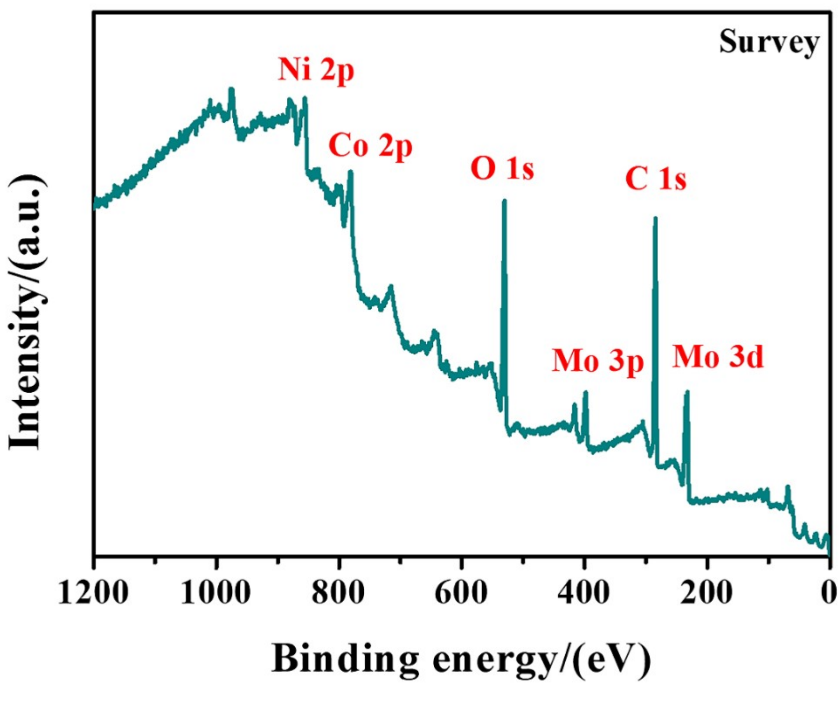

Fig. S3 XPS survey spectrum of $Co_{0.5}Ni_{0.5}MoO_4$@rGO-10

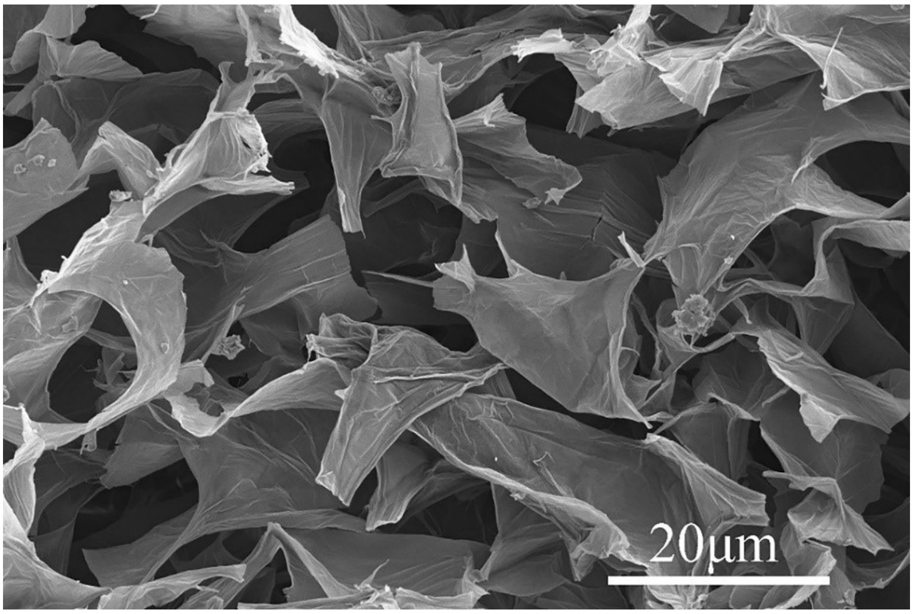

Fig. S4 SEM image of graphene oxide for cathode active materials

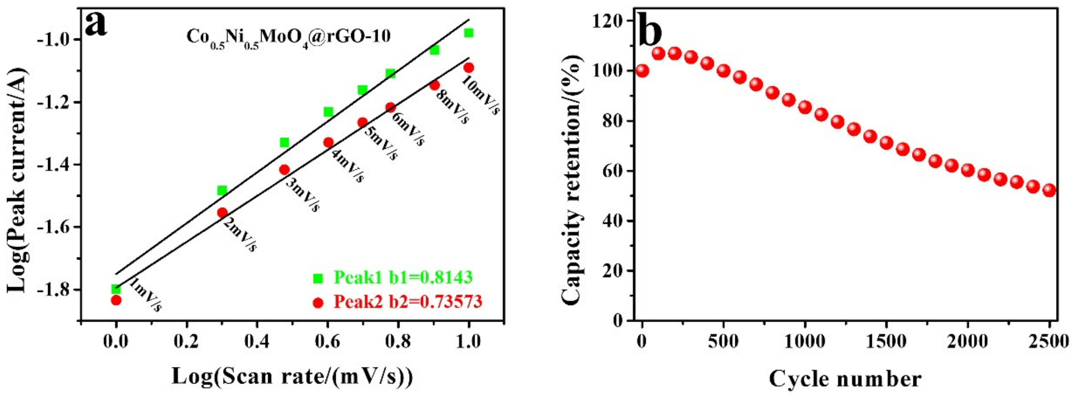

Fig. S5 The relation between the anodic/cathodic peak current and the scan rate of $Co_{0.5}Ni_{0.5}MoO_4$@rGO-10 (a); Cycling performance of $Co_{0.5}Ni_{0.5}MoO_4$@rGO-10 at 15 A/g (b)

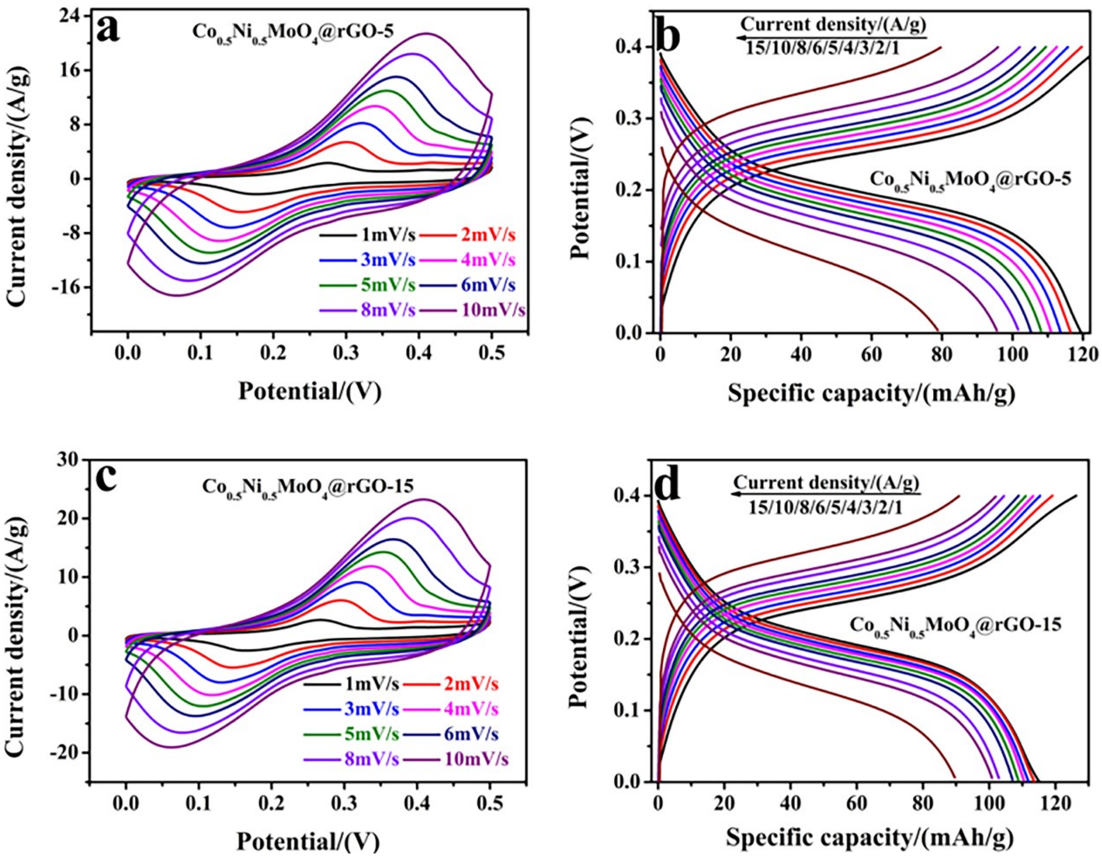

Fig. S6 CV curves of $Co_{0.5}Ni_{0.5}MoO_4$@rGO-5 (a) and $Co_{0.5}Ni_{0.5}MoO_4$@rGO-15 (c); GCD curves of $Co_{0.5}Ni_{0.5}MoO_4$@rGO-5 (b) and $Co_{0.5}Ni_{0.5}MoO_4$@rGO-15 (d)

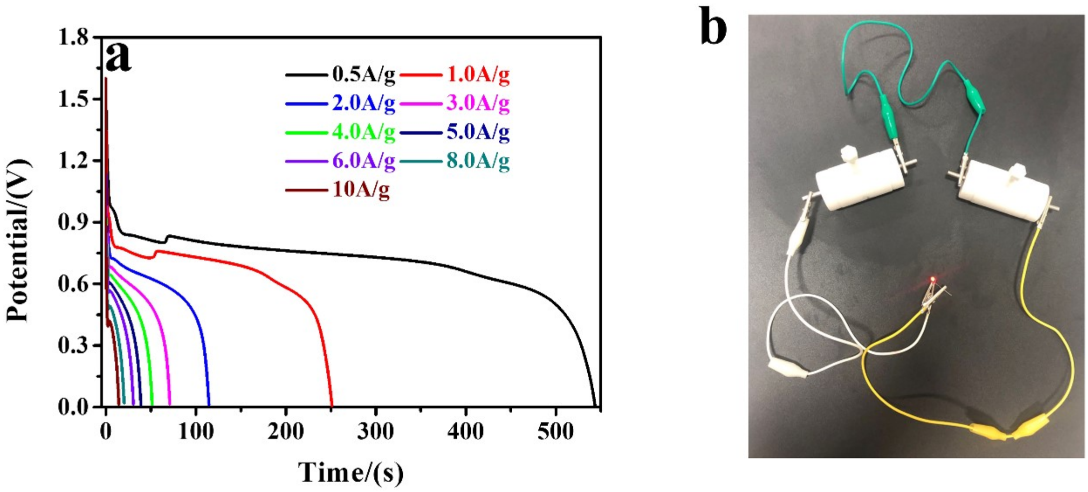

Fig. S7 Discharging curves at different current densities (a); picture shows two devices connected in series can light up one red LED bulb (b)