The supercapattery designed with a binary composite of niobium silver sulfide ($NbAg_2S$) and activated carbon for enhanced electrochemical performance

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Supplementary section

Dunn's model was also used to further elaborate the capacitive and diffusive impact at 20, 40, 60, 80, and 100 mV/s as displayed in Figure 11(a-j). The provided equation was applied to Dunn's model to determine the charge storage contribution.

$$i\,(v) = k_1 v + k_2 v^{0.5} \tag{6}$$

In the above equation, v denotes the scan rate, k_1 and k_2 are the constants, and the current was represented by i. The capacitive participation comes from the $k_1 v$ term, while $k_2 v^{0.5}$ indicates diffusive participation. The system of charge storage was further clarified by dividing equation (6) by $v^{0.5}$.

$$\frac{i(v)}{v^{0.5}} = k_1 v^{0.5} + k_2 \tag{7}$$

The $k_1$and k_2 was measured from the slope of the $\frac{i(v)}{v^{0.5}}$ and $v^{0.5}$ graph. The effect of the increase in scan rate upon the contribution of the charge storage mechanism was measured. As can be seen from Figure 10, the capacitive contribution increases with the scan rate. At 20 mV/s the $NbAg_2S$//AC device shows 72% diffusive and 28% capacitive contribution. The capacitive contribution reaches 68% while the diffusive contribution reduces to 32% at 100 mV/s. These findings indicate that at a lower scan (3 mV/s) the battery-graded electrode had enough time to complete the diffusive reaction, while the capacitive electrode did not have sufficient time, and vice versa at a higher scan (100 mV/s).

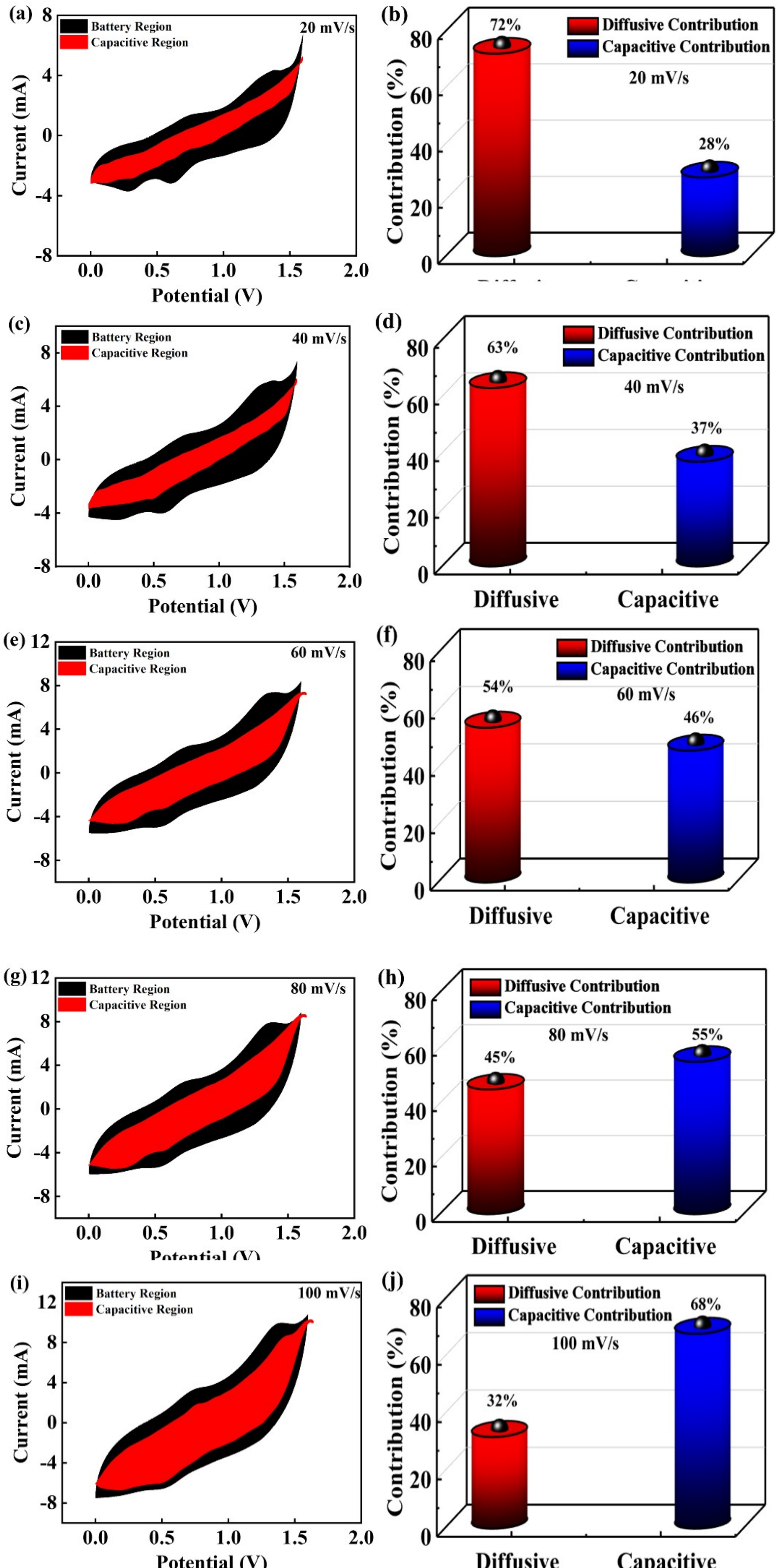
(a)
Battery Region
Capacitive Region
20 mV/s
Current (mA)
Potential (V)
(b)
Diffusive Contribution
Capacitive Contribution
20 mV/s
72%
28%
Contribution (%)
(c)
Battery Region
Capacitive Region
40 mV/s
Current (mA)
Potential (V)
(d)
Diffusive Contribution
Capacitive Contribution
40 mV/s
63%
37%
Contribution (%)
Diffusive
Capacitive
(e)
Battery Region
Capacitive Region
60 mV/s
Current (mA)
Potential (V)
(f)
Diffusive Contribution
Capacitive Contribution
60 mV/s
54%
46%
Contribution (%)
Diffusive
Capacitive
(g)
Battery Region
Capacitive Region
80 mV/s
Current (mA)
(h)
Diffusive Contribution
Capacitive Contribution
80 mV/s
45%
55%
Contribution (%)
Diffusive
Capacitive
(i)
Battery Region
Capacitive Region
100 mV/s
Current (mA)
Potential (V)
(j)
Diffusive Contribution
Capacitive Contribution
100 mV/s
32%
68%
Contribution (%)

Figure S1. (a,j) Indicates the capacitive and diffusive using Dunn's model at 20, 40, 60,80, and 100 mV/s.