Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Supporting information

Pseudo-capacitive Behavior Induced Dual-ion Hybrid Deionization System Based on Ag@rGO‖$Na_{1.1}V_3O_{7.9}$@rGO

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Experimental

Synthesis of graphene oxide (GO): Typically, 2 g graphite powder and 1 g sodium nitrate ($NaNO_3$) were added into a beaker with 50 mL vitriol (H_2SO_4) successively. After the beaker was continuously stirred under the ice bath for 15 minutes, 5 g potassium permanganate ($KMnO_4$) was slowly added and kept stirring under the ice bath for 2 hours. After the beaker rose to room temperature, it kept stirring under 40 ℃ for 2 hours. Then 100 mL DI was added into the beaker and continue the reaction for 30 minutes. Afterwards, 100 mL boiled DI was also added into the beaker and kept stirring for 10 minutes, following moderate hydrogen peroxide (H_2O_2) was added and stood for several hours. The precipitate was washed with DI by using centrifuge until the PH equals to 7. Finally, the precipitate was performed ultrasound and centrifuged for three times to obtain GO flakes.

Synthesis of reduced graphene oxide (rGO) and Ag@rGO: 0.0472 g silver nitrate ($AgNO_3$) was added into a beaker with 60 mL GO (~1 mg/L) and kept ultrasound for 1 hour. Afterwards, a beaker with 15 ml sodium hydroxide (NaOH, 4M) was kept stirring under 85 ℃ and accompanied by adding the solution above drop by drop. Finally, the beaker was kept stirring for 30 minutes. The black precipitate was washed with DI by using centrifuge until the PH equals to 7. For comparison, the rGO was synthesized via the same method without the addition of $AgNO_3$.

Contents

Table and Figures

Table

Table S1 Pore texture of rGO and Ag@rGO.

Sample	S_{BET} (m^2/g)	V (cm^3/g)	D_{avg} (nm)
rGO	29.290	0.113	15.401
Ag@rGO	67.102	0.130	7.743

Table S2 The comparison on salt removal rate of some CDI systems.

Material	Initial concentration (mg/L)	Potential (V)	Salt removal rate (mg/g/min)
C@NTO [7]	250	1.4	1.13
NGCPs [10]	500	1.4	4.14
NMCs-800 [40]	584	1.2	~ 2.5
NHPC [41]	500	1.4	> 2
HPAC [42]	500	1.2	1.09
NP-3DHCA[43]	~ 500	1.2	0.9
3 DHGR [44]	500	1.2	~ 0.8
Ag@rGO‖NVO-250@rGO[This work]	250	1.4	3.84

Figures

Figure S1

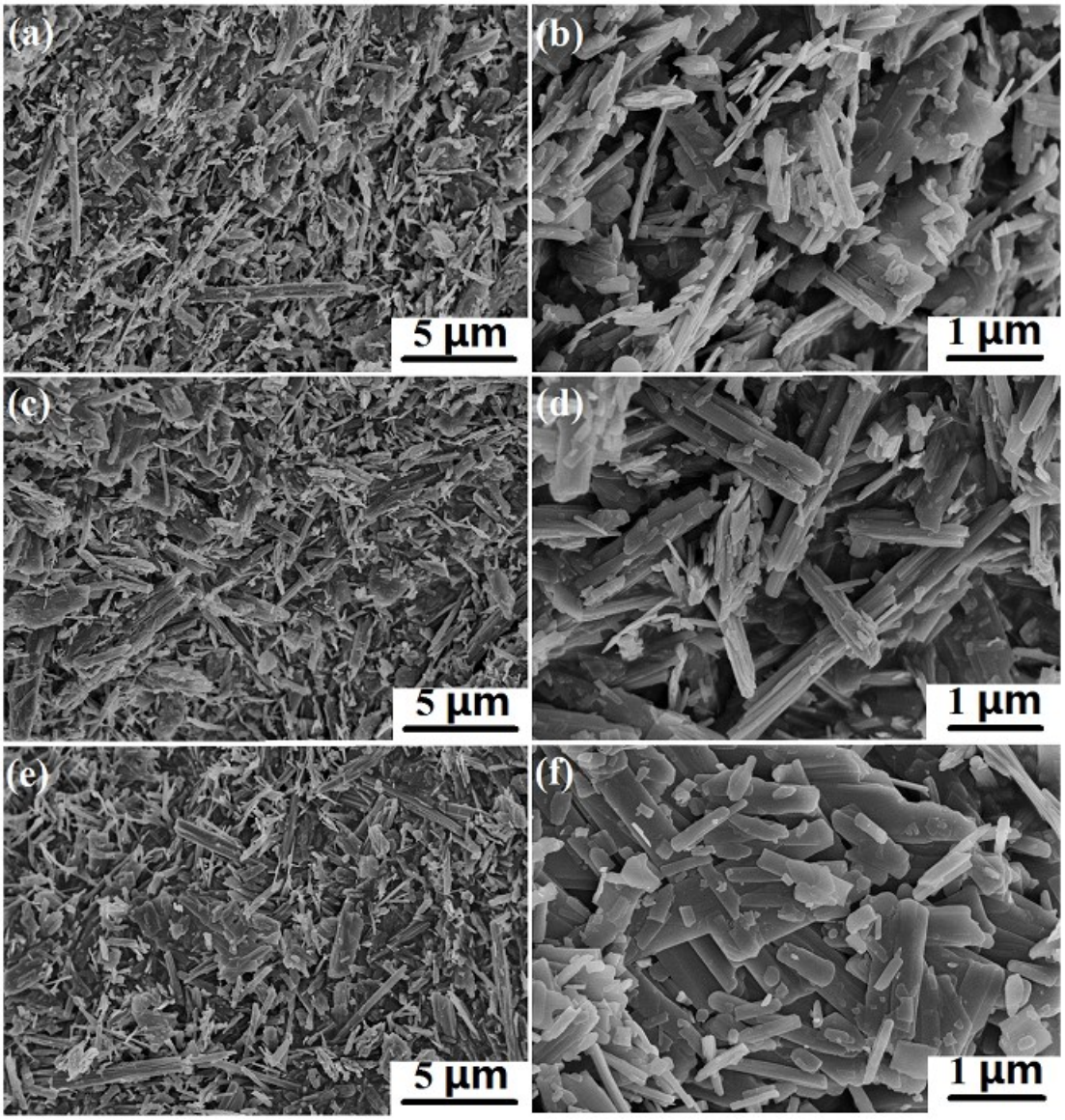

Figure S2

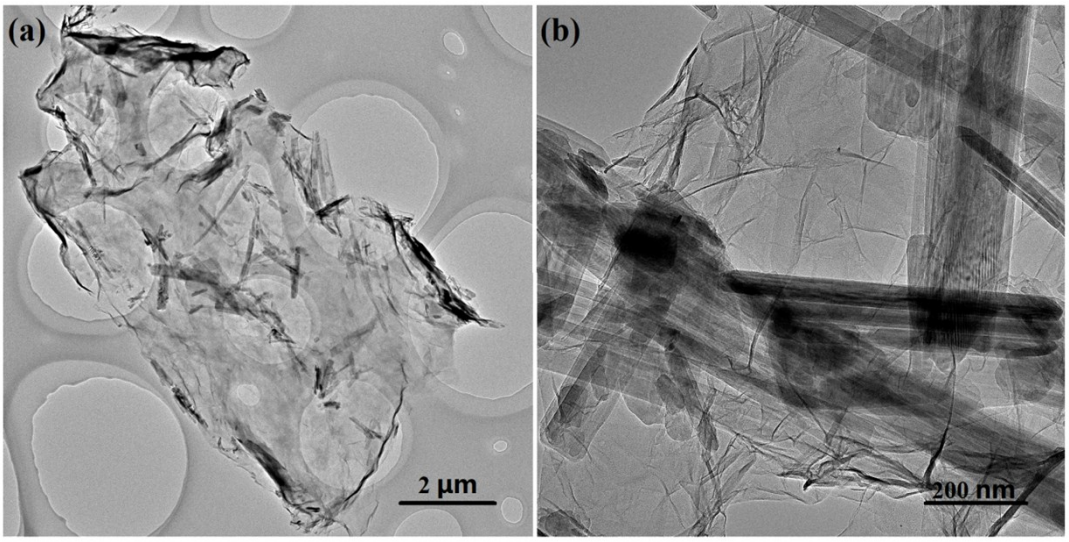

Figure S3

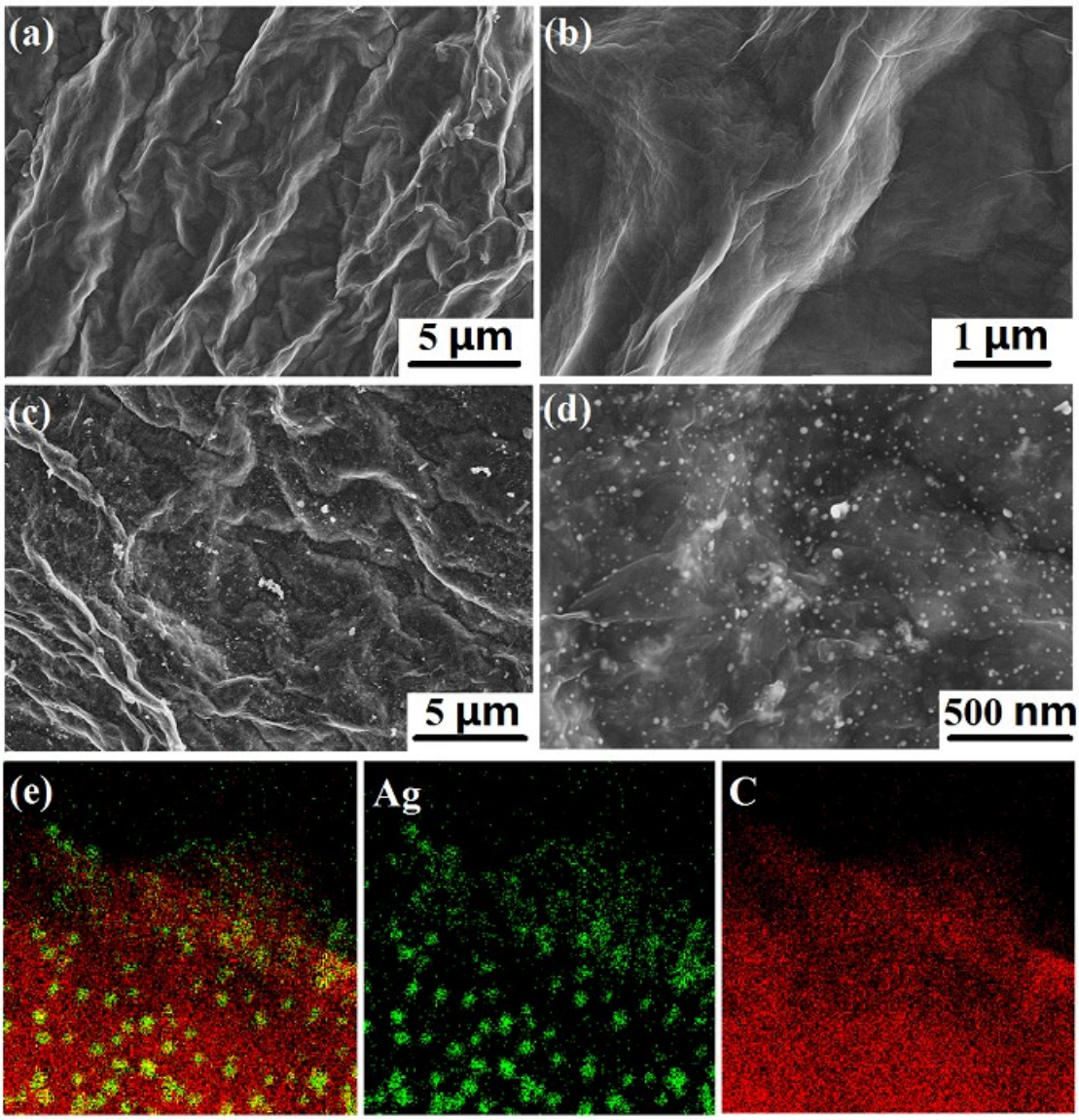

Figure S4

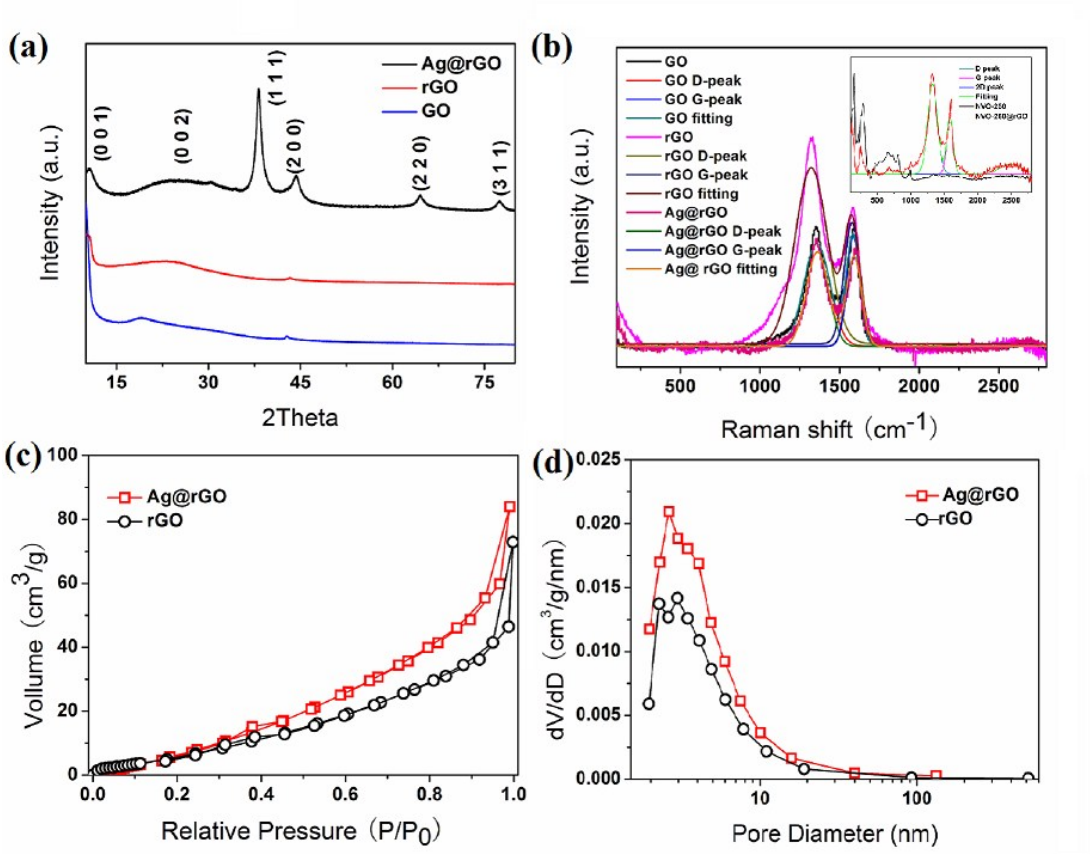
(a)
Ag@rGO
rGO
GO
(0 0 1)
(0 0 2)
(1 1 1)
(2 0 0)
(2 2 0)
(3 1 1)
Intensity (a.u.)
2Theta
(b)
GO
GO D-peak
GO G-peak
GO fitting
rGO
rGO D-peak
rGO G-peak
rGO fitting
Ag@rGO
Ag@rGO D-peak
Ag@rGO G-peak
Ag@ rGO fitting
Intensity (a.u.)
Raman shift (cm-1)
(c)
Ag@rGO
rGO
Vollume (cm3/g)
Relative Pressure (P/P0)
(d)
Ag@rGO
rGO
dV/dD (cm3/g/nm)
Pore Diameter (nm)

Figure S5

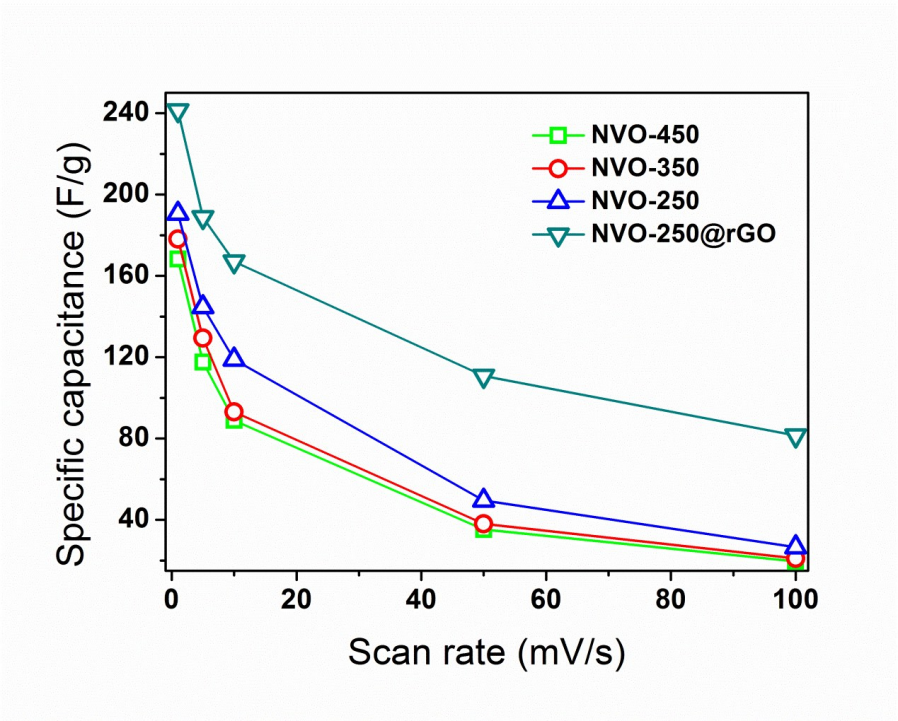
Specific capacitance (F/g)
240
200
160
120
80
40
0
20
40
60
80
100
Scan rate (mV/s)
NVO-450
NVO-350
NVO-250
NVO-250@rGO

Figure S6

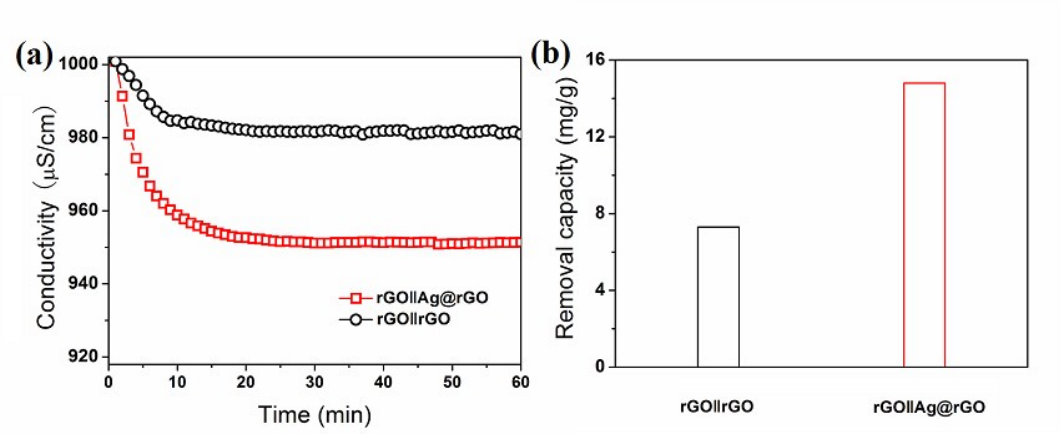
(a)
Conductivity (μS/cm)
Time (min)
rGO||Ag@rGO
rGO||rGO
(b)
Removal capacity (mg/g)
rGO||rGO
rGO||Ag@rGO

Figure S7

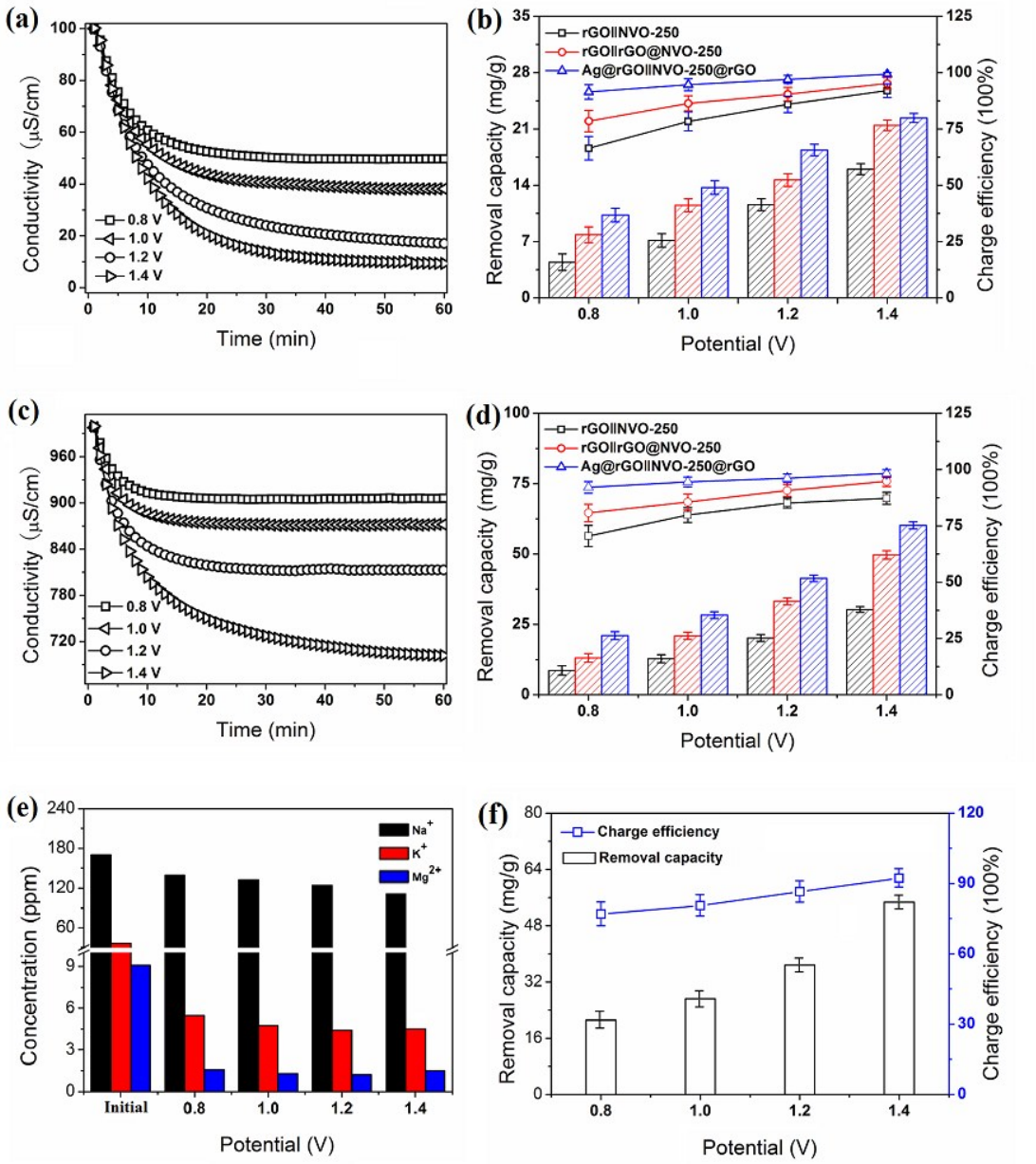
(a)
Conductivity (μS/cm)
Time (min)
0.8 V
1.0 V
1.2 V
1.4 V
(b)
rGO||NVO-250
rGO||rGO@NVO-250
Ag@rGO||NVO-250@rGO
Removal capacity (mg/g)
Charge efficiency (100%)
Potential (V)
(c)
Conductivity (μS/cm)
Time (min)
0.8 V
1.0 V
1.2 V
1.4 V
(d)
rGO||NVO-250
rGO||rGO@NVO-250
Ag@rGO||NVO-250@rGO
Removal capacity (mg/g)
Charge efficiency (100%)
Potential (V)
(e)
Concentration (ppm)
Na+
K+
Mg2+
Initial
Potential (V)
(f)
Charge efficiency
Removal capacity
Removal capacity (mg/g)
Charge efficiency (100%)
Potential (V)

Figure S8

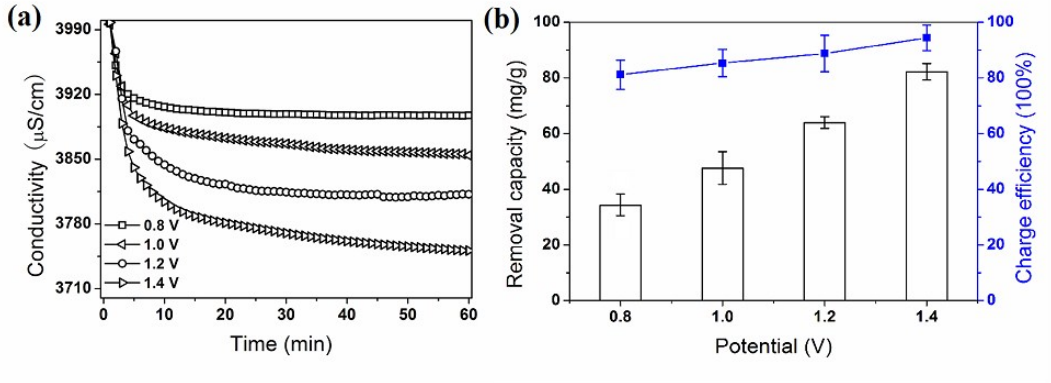
(a)
Conductivity (μS/cm)
Time (min)
0.8 V
1.0 V
1.2 V
1.4 V
(b)
Removal capacity (mg/g)
Charge efficiency (100%)
Potential (V)

Figure S9