

## Supporting Information

### **Improved Hummer's method derived graphene oxide wrapped ZIF-8 polyhedron derived porous heterostructure for symmetric supercapacitor's performance**

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#### **S1. Materials and Instrumentation**

Commercial Graphene oxide(GO), Graphite powder, cetyltrimethylammonium bromide (CTAB), U. S. Standard testing sieve, Zinc acetate, and 2, methyl imidazole are directly purchased from sigma Aldrich. These all are used without further purification.

#### **Preparation of Improved hummer's method derived Graphene Oxide (IGO)**

IGO has been synthesized as per the reference.<sup>1</sup> IGO was prepared from commercial graphite powder by using the modified Hummers method. Briefly, graphite powder (3.0 g) was suspended in a mixture of concentrated H<sub>2</sub>SO<sub>4</sub> (360 mL) and H<sub>3</sub>PO<sub>4</sub> (40 mL) under continuous stirring for 0.5 h. The mixture was placed in an ice bath to keep the temperature below 10 °C and KMnO<sub>4</sub> (18 g) was slowly added by stirring. Subsequently, the mixture was transferred to a 500 mL round bottom flask and heated at 50 °C under constant stirring for 12 h. After cooling to room temperature, the resulting dark solution containing the product was poured onto ice (~450 mL) containing 30% H<sub>2</sub>O<sub>2</sub> (3 mL). The resulting mixture (yellowish-brown color) was then passed through a U.S. Standard testing sieve (Sigma Aldrich, 300 μm) and then filtered through a polyester fiber to separate larger particles (unconverted graphite). The collected filtrate containing IGO was centrifuged (8500 rpm, 10 min), and the supernatant was decanted away. The collected IGO was washed in succession with water (200 mL), dilute HCl (30%, 200 mL), and ethanol (200 mL). After each wash, IGO was collected by centrifugation (8500 rpm, 10 min), followed by coagulation with 200 mL of diethyl ether. The resulting suspension was centrifuged to obtain pure IGO which was dried at room temperature under a vacuum.

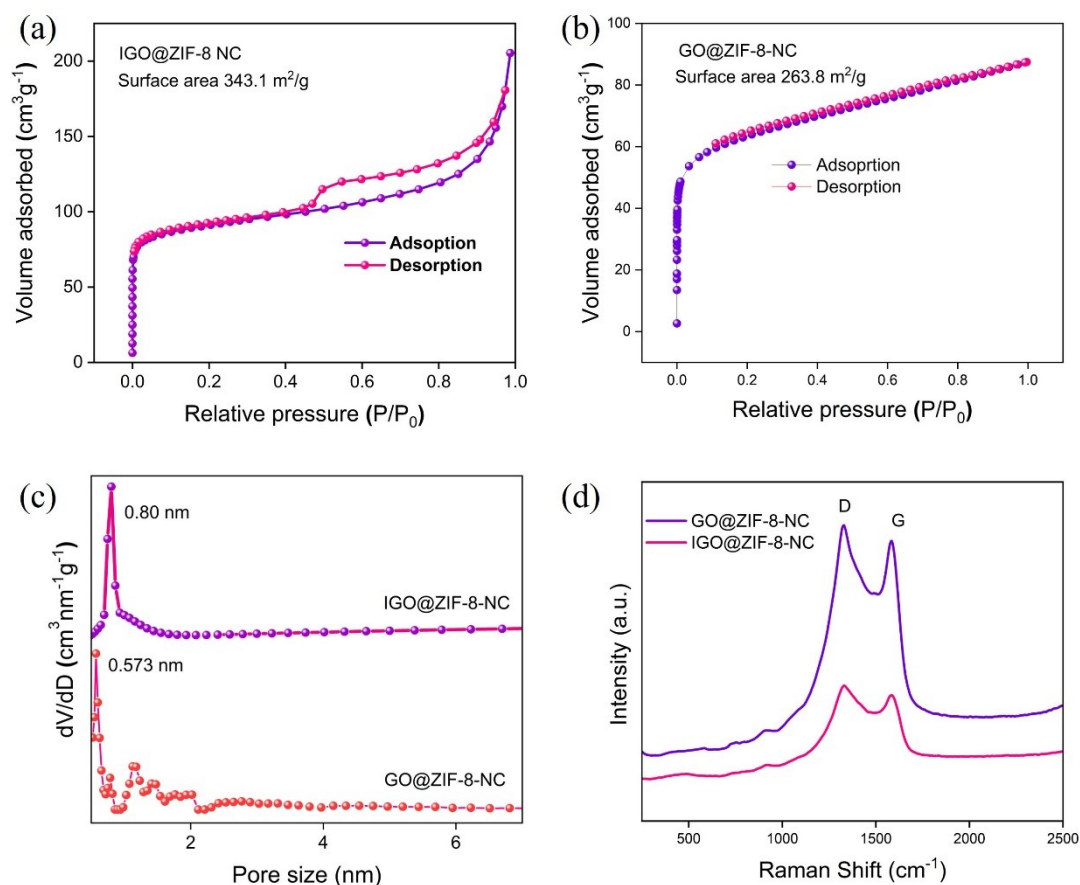
#### **Synthesis of IGO@ZIF-8:**

Typically, 600 mg of Zn(CH<sub>3</sub>COO)<sub>2</sub>·2H<sub>2</sub>O was dissolved in 10 mL of water. The aqueous suspension of (IGO at the concentration of 5mg ml<sup>-1</sup>) in 16 ml water was sonicated for 1 hour. 1.12 g of MeIM and 2.0 mg of cetyltrimethylammonium bromide (CTAB) were dissolved in 10 mL of water by sonication. Then the solution of Zn(CH<sub>3</sub>COO)<sub>2</sub> and IGO suspension was added to the solution of MeIM and CTAB and gently stirred for 10 minutes. The mixture was left undisturbed at room temperature (RT) for **2 h**. Further IGO@ZIF-8 composite is separated by centrifugation and dried at 60 °C for 12 hours in oven.

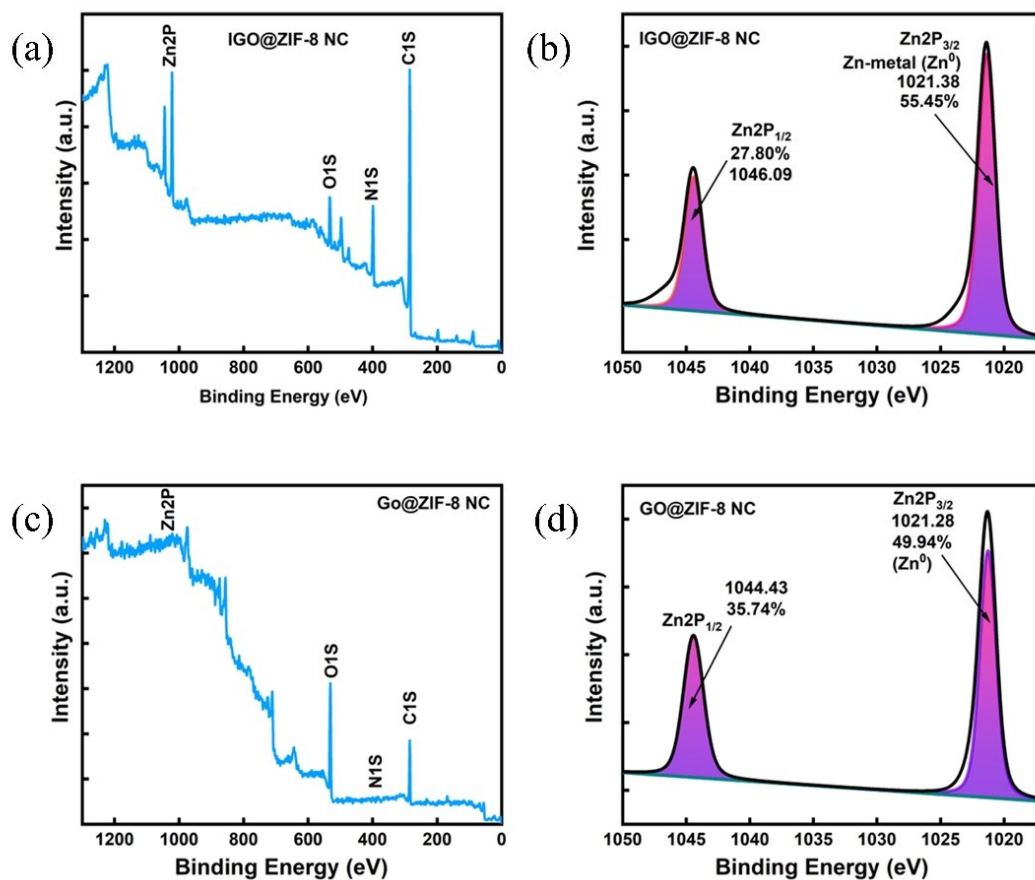
#### **Synthesis of IGO@ZIF-8 NC:**

IGO@ZIF-8 NC was prepared by direct pyrolysis of ZIF-8 at 700 °C for 2 h under an Argon atmosphere with a heating rate of 5 °C min<sup>-1</sup>. After cooling down to room temperature, the carbon was washed with 1 m HCl solution, DI water, and ethanol, respectively.

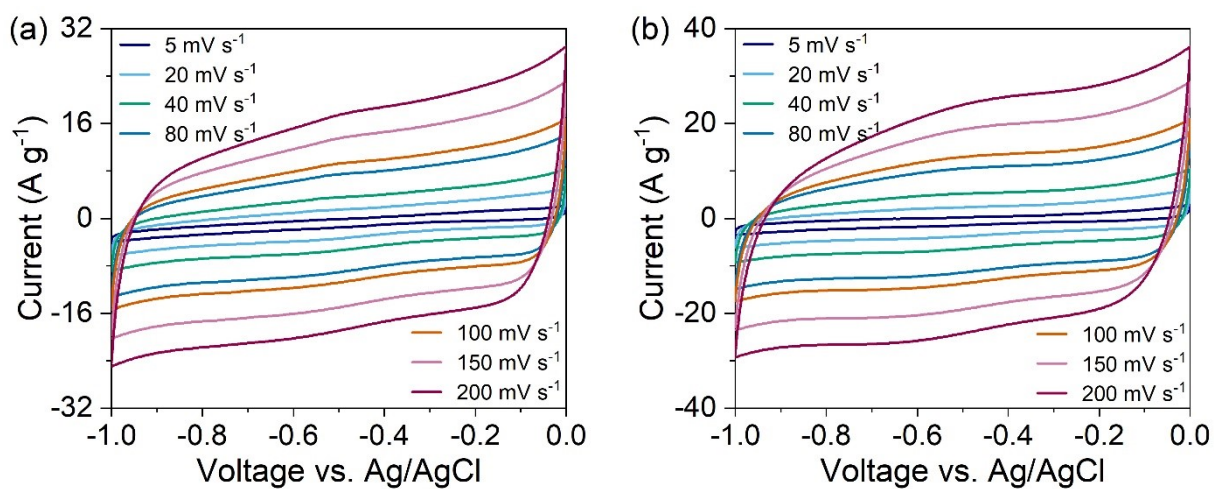
**GO@ZIF-8 NC:** GO@ZIF-8 NC also prepared by the same procedure by replacing IGO with graphene oxide (GO)



**Figure S1.** BET surface area and BJH pore distribution curve of IGO@ZIF-8-NC (a). Pore size distribution curve of IGO@ZIF-8-NC and GO@ZIF-8-NC (b). BET surface area and BJH pore distribution curve of GO@ZIF-8-NC (c). Raman spectral plots of IGO@ZIF-8-NC and GO@ZIF-8-NC (d).

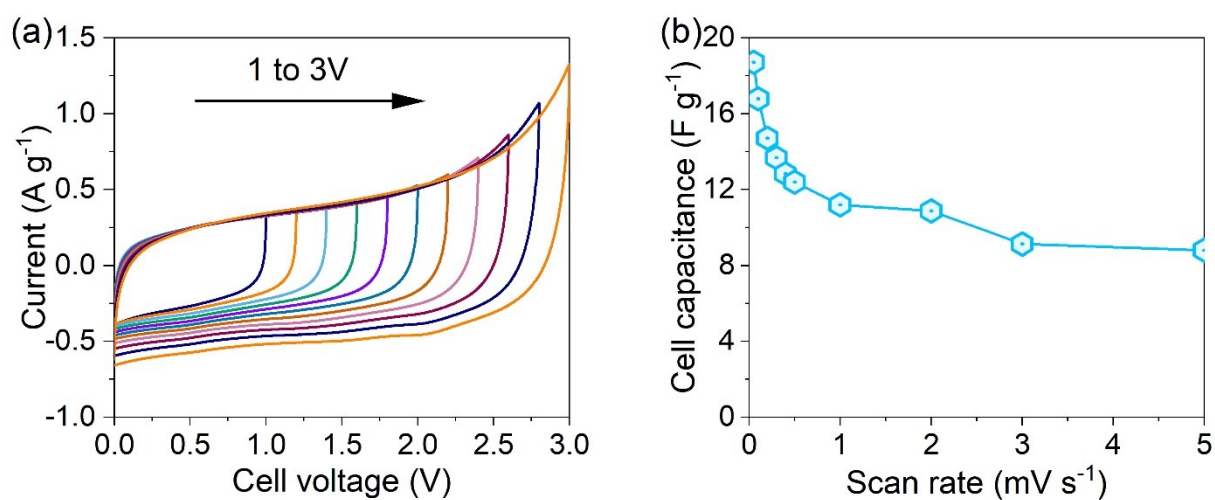


**Figure S2.** XPS spectrum for (a-c) O1S (d-f) Zn2P for IGO@ZIF-67 NC, GO@ZIF-8 NC and ZIF-8 NC.

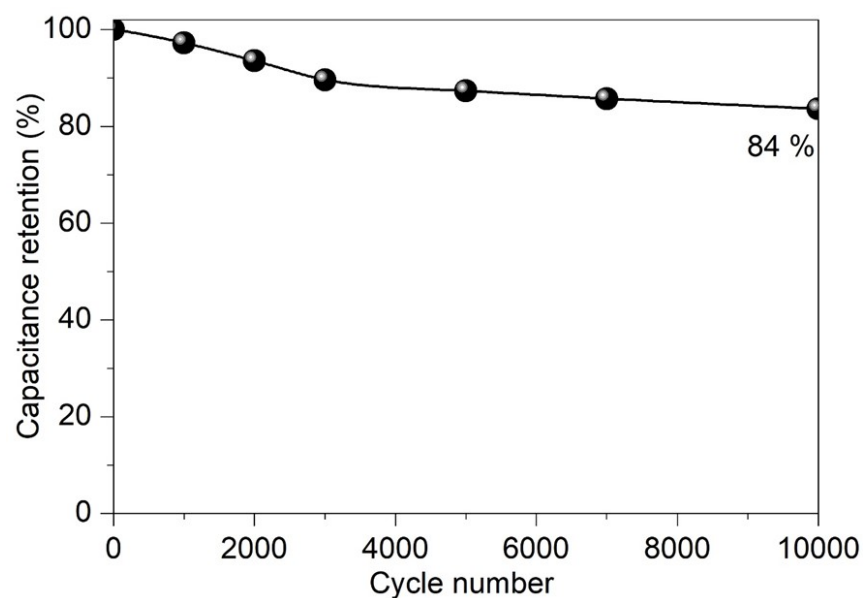


**Figure S3.** CV curves at different scan rates for a) GO@ZIF-8-NC, and (b) IGO@ZIF-8-NC.

The IGO@ZIF-8-NC sample shows more enclosed area under the curve, hence showing its improved electrochemical activity compared to GO@ZIF-8-NC.



**Figure S4.** Cell voltage versus current plot for 1 to 3V (a), and capacitance versus scan rate to judge efficiency.



**Figure S5.** Cycling test the SSC device fabricated by IGO@ZIF-8-NC.

**Table S1.** Atomic percentage of each element calculated from XPS survey spectra.

<b>Elements</b>	<b>IGO@ZIF-8- NC</b>	<b>ZIF-8-NC</b>	<b>GO@ZIF-8NC</b>
C1s	71.13	74.34	75.14
N1s	14.84	11.92	10.74
O1s	7.26	9.72	10.72
Zn2p	3.84	2.01	1
Cl2p	2.93	2.01	1.21

**Table S2.** Three electrode capacitance comparison in reported literature in Figure 4(c).

S.N.	Material	Electrolyte	Capacitance (F g <sup>-1</sup> )	Reference
1.	Porous carbon from ZIF-7	6 M KOH	228	2
2.	Porous carbon from ZIF-8	1 M H <sub>2</sub> SO <sub>4</sub>	251	3
3.	Carbon-ZS*	6 M KOH	285.8	4
4.	3D Porous carbon	6 M KOH	332	5
5.	Porous carbon derived from DUT-5	6 M KOH	119	6
6.	MZIF-derived carbon with Ni sites	3M KOH	262	7
7.	MOF-derived hierarchical carbon nanofibers	Aqueous	332	8
8.	MOF-derived carbon nanosheets	6 M KOH	278	9
9.	ZIF-67 derived porous carbon	6M KOH	223	10
10.	Porous carbon	6 M KOH	316.3	11
11.	MOF-5 derived carbon	1 M H <sub>2</sub> SO <sub>4</sub>	195.4	12
12.	Co/Zn-ZIF-derived NPC	0.5 M H <sub>2</sub> SO <sub>4</sub>	286	13
13.	Porous carbon	6 M KOH	271	14
14.	rGO/CMOF-5 *based carbon	6 M KOH	312	15
15.	ZIF-8@MWCNT*-derived carbon	1 M H <sub>2</sub> SO <sub>4</sub>	326	16
16.	MOF-5-derived carbon nano-spheres	6 M KOH	300	17
17.	ZIF-8-derived porous carbon	1M H <sub>2</sub> SO <sub>4</sub>	290	18
18.	rGO-NPC	6M KOH	334	19
19.	MOF-74 derived carbon	1 M H <sub>2</sub> SO <sub>4</sub>	187	20
20.	GO@ZIF-8-NC	3M KOH	287.5	This work
21.	IGO@ZIF-8-NC	3M KOH	352.8	This work

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