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Efficient reduction of graphene oxide using Tin-powder and its electrochemical performances for energy storage electrode material

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Table S1 Comparison of properties of reduced GOs produced by various reducing agents

Reducing agent	Temperature (^{o}C)	Reduction Time	C:O ratio by XPS (atomic ratio)	Electrical conductivity ($S\ m^{-1}$)	Specific capacitance ($F\ g^{-1}$)	Reference No
Al(powder)/ HCl	RT	30 min	18.6	2,100	-------	1
Al(foil)/HCl	RT	6 h	21.11	12,530	-------	2
Al(foil)/NaOH	RT	30 min	5.35	1,120	-------	2
Fe(powder)/ HCl	RT	6 h	7.9	2,300	-------	3
Zn(powder)/ ammonia	RT	10 min	8.05	2,160	116 at 0.05 A g^{-1}	4
Zn(filings)/H_2SO_4	RT	2 h	21.2	3,416	176	5
Zn(powder)/NaOH	RT	20 min	17.96	7,540	-------	2
Zn(powder)/ neutral solutions in the presence of EDTA*	RT	1 min Ultrasonic ation	33	14,200	-------	6
Zn(powder)/NaOH	RT	1 min Ultrasonic ation	31.2	13,500	-------	6
Zn(powder)/NaOH	RT	6 h	6.02		-------	7
Zn(powder)/NaOH	100	6 h	7.39		-------	7
Zn(powder)/HCl	RT	30 min	8.2	650	-------	8
Ni(powder)/HCl	RT	24 h			-------	9
Mg(ribbons)/HCl	RT	5 min		10.12	-------	10
$NaBH_4$	RT	2 h	8.6	45	-------	11
Hydrazine hydrate	100	24 h	10.3	~200	-------	12

Solvothermal Sodium + ethanol	220	72 h	6.4	0.05	-------	13
HI Hydrohalic acids	100	1h	12	298	-------	14
Reduction with H_2	450	2 h	10.8	100,000	-------	15
Yeast	35-40	72 h	5.9	43	-------	16
Polyethylene imine	80	2 h	5.6	0.783	-------	17
Vitamin C	95	-------	12.5	7,700	-------	18
Isopropanol	100	5 days	6.9	1,019	2.8	19
Benzyl alcohol	100	5 days	30	4,600	35	19
Glycine	RT	12 h	11.14		-------	20
P-phenylene diamine	90	24 h	7.4	1,500	-------	21
Wild carrot	RT	72 h	11.9		-------	22
Pyrrole	95	12 h	7.7	45	-------	23
Hydroxyl amine	90	1 h	9.7	1,122	-------	24
L-ascorbic acid	RT	48 h	-------	800	-------	24
Sn(powder)/ HCl	50	3 h	6.1	8,650	152 at 1.5 A g-1	Current work

* EDTA refers Ethylenediaminetetraacetic acid and RT represents room temperature.

Table S2 Comparative electrochemical performances of various reduced GOs, surface modified graphene and graphene/conducting polymer composites

Materials	Specific capacitance	Charge-discharge cyclicstability/Retention	References
Zn reduced GO	116 F g^{-1} at 0.05 A g^{-1}	-----------	4
Zn reduced GO	176 F g^{-1}	-----------	5
Dimethyl ketoxime reduced GO	141 F g^{-1} at 3 A g^{-1}	96% after 1500 cycles	25
Aqueous phytoextracts reduced GO	21(±2) F g^{-1} for ORGO, 18(±2) F g^{-1} for MRGO 17(±1.5) F g^{-1} for CRGO**	-----------	26
Hydrazine monohydrate reduced GO	101 F g^{-1} at 20 mV s^{-1} 97 F g^{-1} at 400 mV s^{-1}	-----------	27
Annealing at 150 ◦c for 12 h	72 F g^{-1} at 5 A g^{-1}	82% after 1500 cycles	28
Alcohols reduced GO	35 F g^{-1} at 25 mV s^{-1}	-----------	19
Thermally reduced GO	48 to 132 F g^{-1} at a scan rate of 0.5 to 0.01 V s^{-1}	-----------	29
Hydrazine reduced GO	133 F g^{-1} at 1 A g^{-1}	-----------	30
Electrochemically-reduced GO	128 F g^{-1}	86% after 3500 cycles	31
Thermally exfoliated and reduced GO	117 F g^{-1} in aq. H_2SO_4 75 F g^{-1} in ionic liquid	-----------	32
low-temperature (as low as 200 °C) reduced GO	122 F g^{-1} at 100 mA g^{-1}	-----------	33
9-anthracene carboxylic acid functionalized graphene	148 F g^{-1}	-----------	34
Sulfonated poly(ether-ether-ketone)	476 F g^{-1} at 6.6 A g^{-1}	-----------	35
KOH activated graphene sheets	136 F g^{-1} at 10 mVs^{-1}	-----------	36
Primary amine (Ethylene glycol)	187.6 F g^{-1} at 0.8 A g^{-1}	60% after 1000 cycles	37
Reduced GO/polypyrrole composite	224 F g^{-1} at 240 Ag^{-1}	83% after 5000 cycles	38
Multilayered nanoarchitecture of graphene nanosheets and	165 F g^{-1} at 1 A g^{-1}	92% after 5000 cycles	39

polypyrrole nanowires			
Graphene-polypyrrole nanocomposite	267 F g^{-1} at 100 mV s^{-1}	90% after 500 cycles	40
Sandwich-like polyaniline/graphene composite	377 F g^{-1} at 100 mV s^{-1}	50.9 % after 1000 cycles	41
Electrophoretic deposition method to make the graphene nanosheets on nickel foam	100 F g^{-1} at 6 A g^{-1}	61% after 700 cycles	42
Free-standing graphene/polyaniline nanofibers PSS-GS/PANi (10%)	301 F g^{-1}	67% after 400 cycles	43
Sn-reduced GO at 50 ^{o}C	152 F g^{-1} at 1.5 A g^{-1}	92% after 1500 cycles	Current work

**MRGO and ORGO represent M. ferrea Linn. leaf aqueous extract reduced GO and C. sinensis peel aqueous extract reduced GO, respectively. CRGO represents C. esculenta leaf aqueous extract reduced GO

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