Electronic Supporting Information

Fast Synthesis of High-Quality Reduced Graphene Oxide at Room Temperature under Light Exposure

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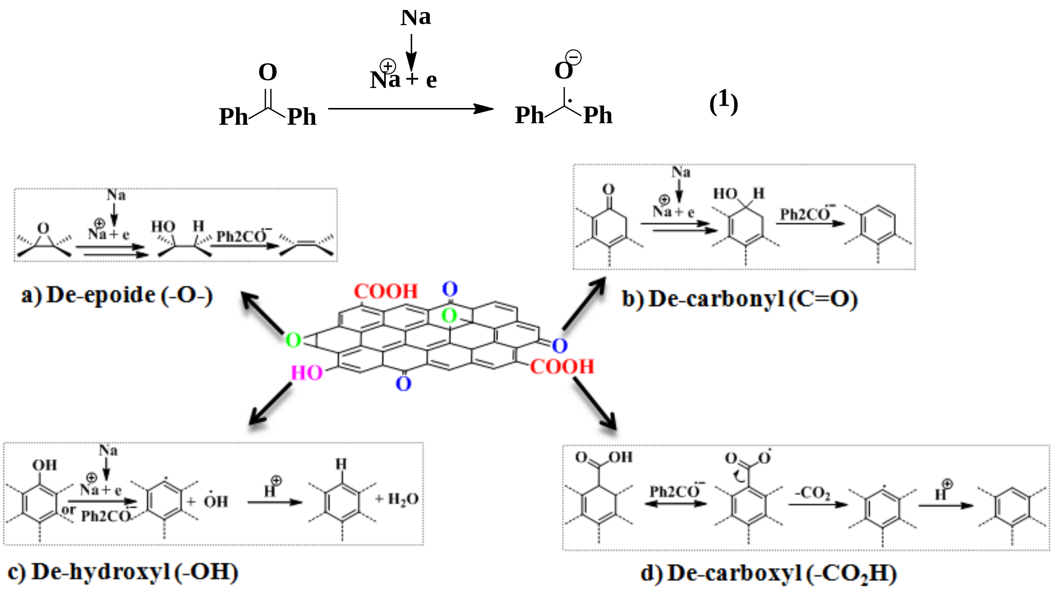

Figure S1. Possible reduction mechanism and procedure for preparing the $rGO_{Na\text{-}B1}$ sheets with solvated radical anion with electron from sodium.[1,2,3]

$$Na + N_2H_4 \longrightarrow 2NaN_2H_3 + H_2 \qquad (2)$$

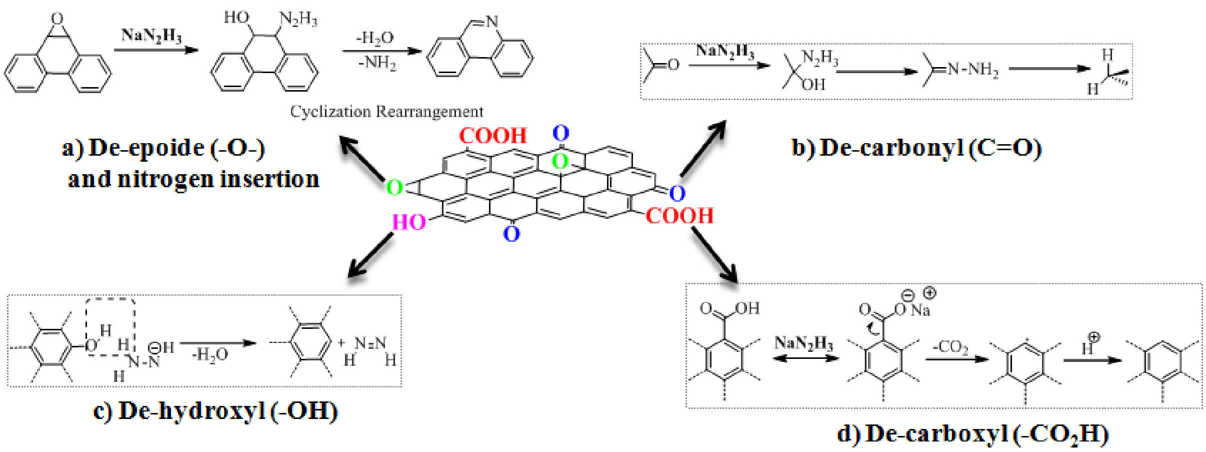

Figure S2. Possible reduction mechanism and procedure for preparing the $rGO_{Na\text{-}H3}$ and $rGO_{Na\text{-}H4}$ sheets with sodium hydrazide complex, NaN_2H_3.[4,5,6]

As per our hypothesis, in case of formation of the $rGO_{Na\text{-}B\text{-}H2}$ sheets by the use of Na-B-H reducing system, both mechanisms were employed.

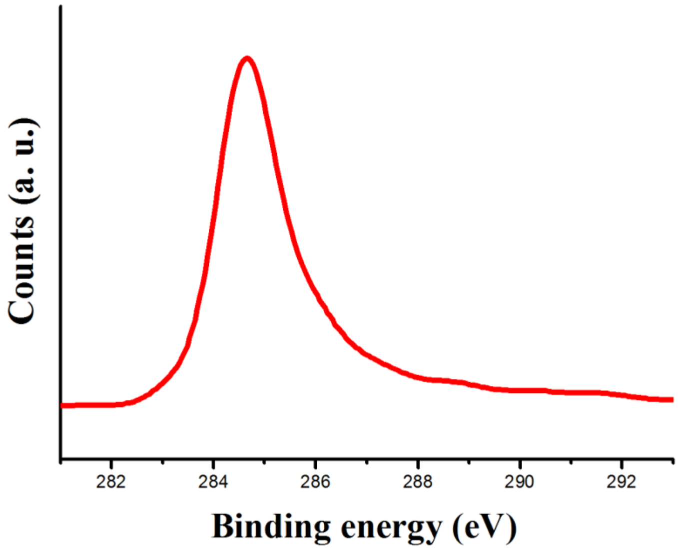

Figure S3. XPS spectra of graphite.

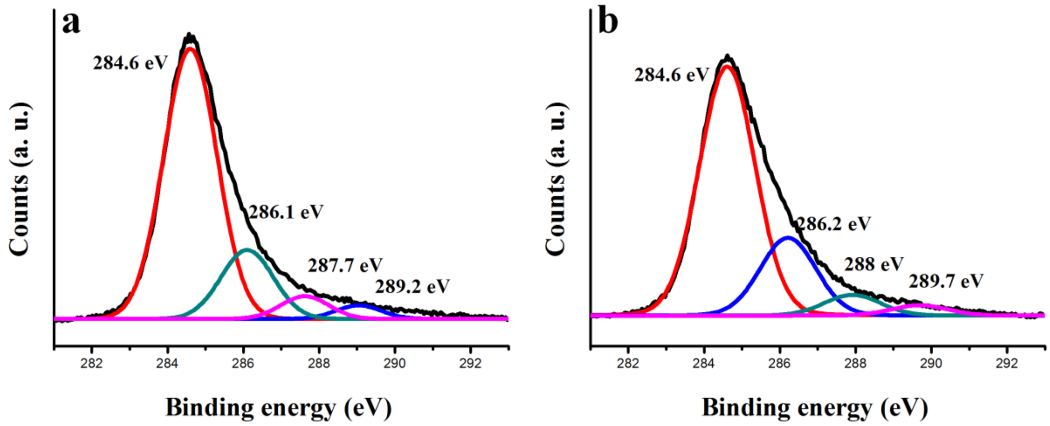

Figure S4. C1s spectra of $rGO_{Na\text{-}H3}$ (a) and $rGO_{Na\text{-}H4}$ (b) sheets.

The C1S of $rGO_{Na\text{-}H3}$ contained the peaks at 286.1 eV (C-O and C-N combined), 287.7 eV (C=O), 289.2 (C(O)OH)); whereas C1S of $rGO_{Na\text{-}H4}$ contain the peaks at 286.2 eV (C-O and C-N combined), 288 eV (C=O), 289.7 (C(O)OH).

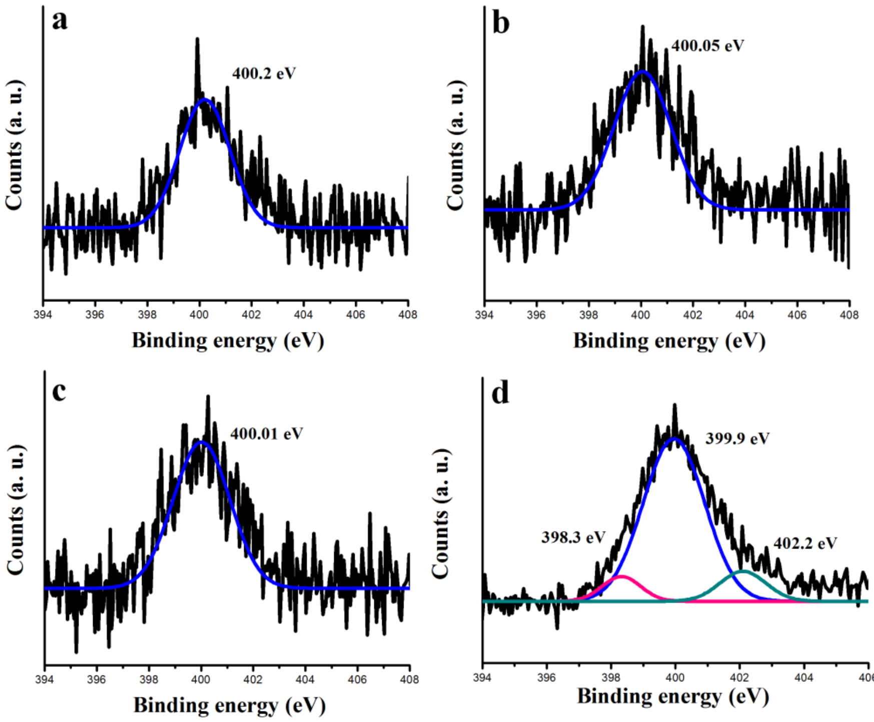

Figure S5. N1s spectra of $rGO_{Na\text{-}B\text{-}H2}$ (a), $rGO_{Na\text{-}H3}$ (b), $rGO_{Na\text{-}H4}$ (c) and rGO_{H} (d) sheets.

In the N1s peaks in the XPS spectra; peak was found about ~398 eV, which could be attributed to pyridinic N, the peak ~400 eV were attributed to amide, amine, or pyrrolic N, and the peak at ~402 eV is commonly attributed to oxidized nitrogen.[6]

Table S1. Comparison of XPS analysis results of as made rGOs.

Entry	Reduction Process	Temperature	C/O	N (%)	N1s (eV)
1.	GO	-	2.01	0.32	-
2.	Sodium-Benzophenone / UV light	rt	13.9	0.38	-
3.	Sodium-Benzophenone-Hydrazine / UV light	rt	16.2	3.8	400.2
4.	Sodium-Hydrazine dil	~50 °C	10.9	2.9	400.05
5.	Sodium-Hydrazine Conc	~50 °C	12.6	4.1	400.02
6.	Hydrazine	100 °C	12.1	3.4	398.3, 399.9, 402.2
7.	Graphite	-	71.8	0.1	-

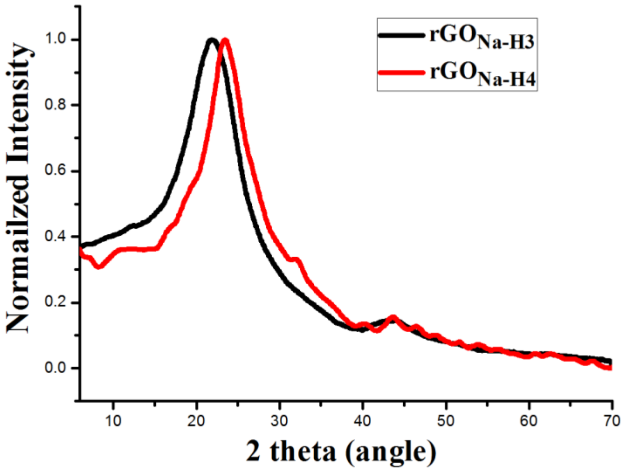

Figure S6. XRD spectra of $rGO_{Na\text{-}H3}$ and $rGO_{Na\text{-}H4}$ sheets.

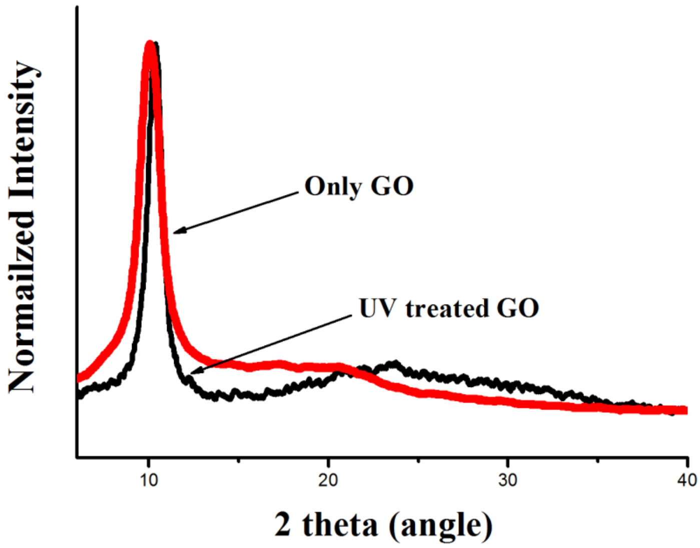

Figure S7. XRD spectra of only GO and GO solution treated with UV lamp for 24 h.

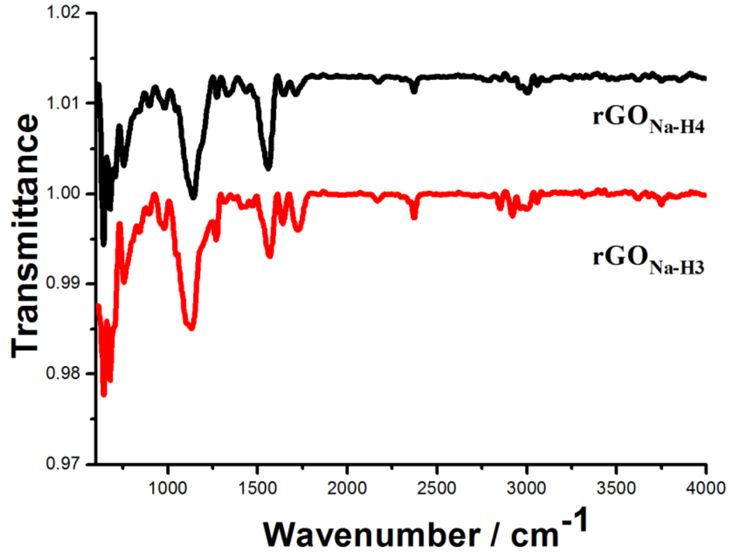

Figure S8. FTIR spectra of $rGO_{Na\text{-}H3}$ and $rGO_{Na\text{-}H4}$ sheets.

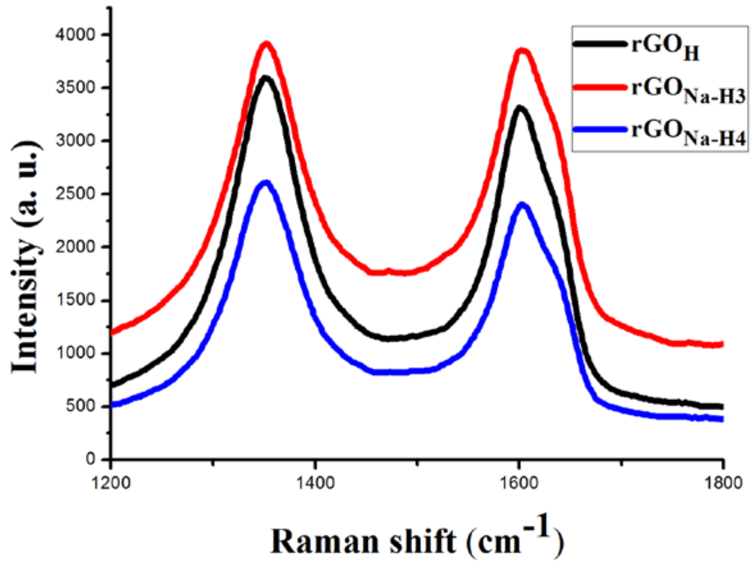

Figure S9. Raman spectra of rGO_H, $rGO_{Na\text{-}H3}$ and $rGO_{Na\text{-}H4}$ sheets.

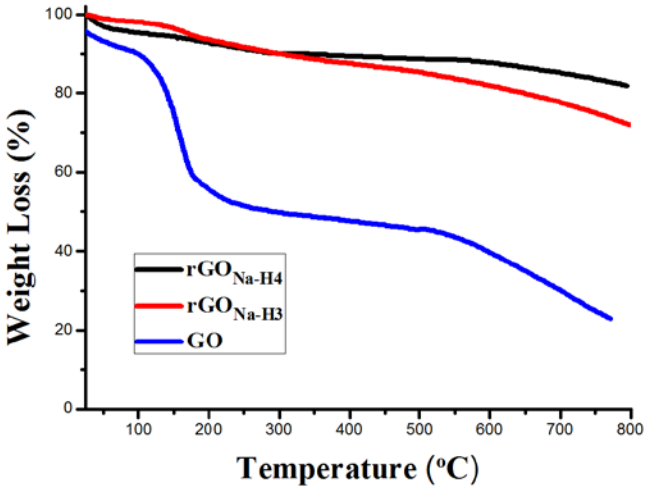

Figure S10. TGA thermograms for GO, rGO$_{Na-H3}$ and rGO$_{Na-H4}$ sheets.

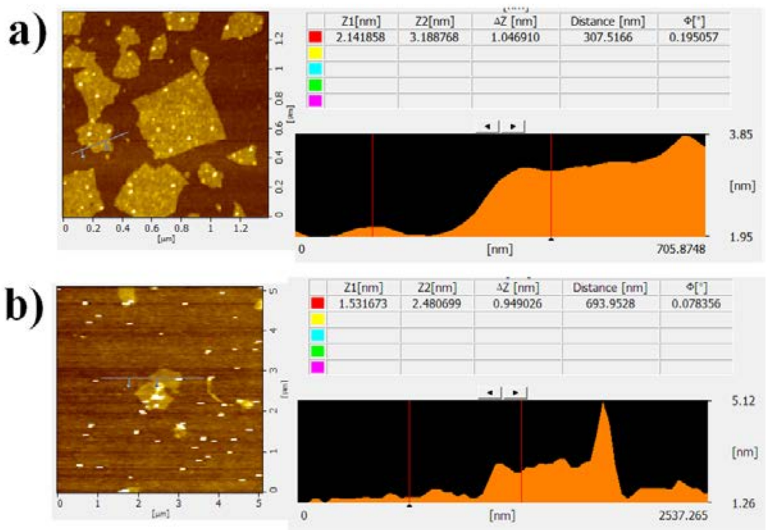

Figure S11. (a) AFM image of as-prepared rGO$_{Na-B1}$ sheet using Na-B system. (b) AFM image of as-prepared rGO$_{Na-B-H2}$ sheet using Na-B-H system.

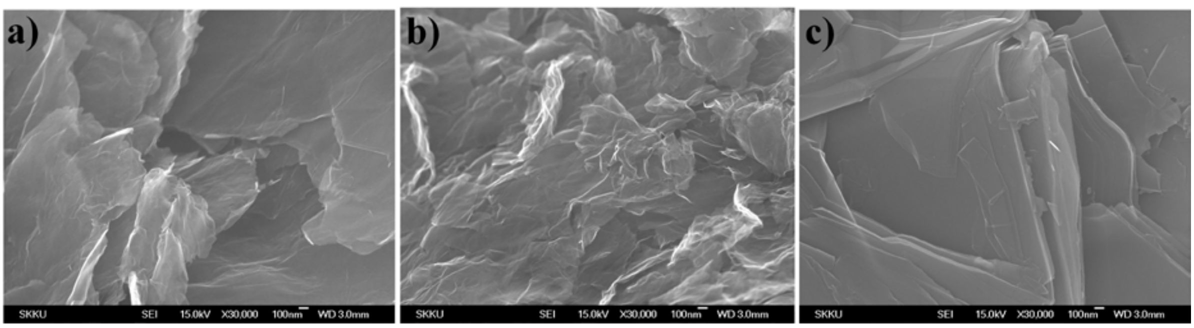

Figure S12. SEM images of (a) rGO$_{Na-H3}$, (b) rGO$_{Na-H4}$ sheets and (c) graphite.

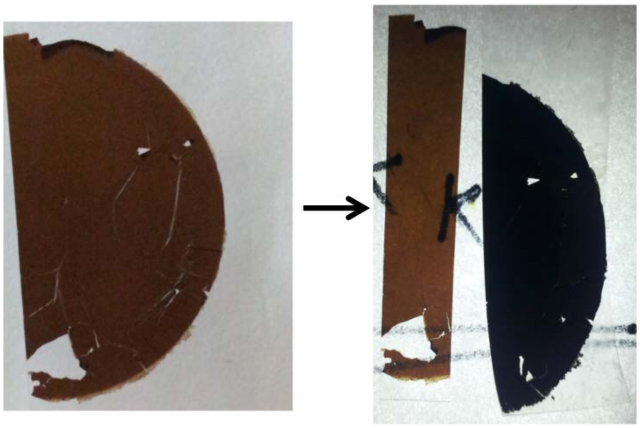

Figure S13. Photograph of GO and rGO film on PET.

Table S2. Comparison of sheet resistance of as made rGOs.

Entry	Type	Sheet resistance Ω/square	Thickness of film or pellets (µm)
1.	$rGO_{Na\text{-}B1}$	~200 ~9	~4.2 (film) ~11.1 (pellet)
2.	$rGO_{Na\text{-}B\text{-}H2}$	~130 ~5	~4.1 (film) ~10.8 (pellet)
3.	$rGO_{Na\text{-}H3}$	~20	~11.5 (pellet)
4.	$rGO_{Na\text{-}H4}$	~18	~10.2 (pellet)
5.	rGO_{H}	~32	~12 (pellet)

Table S3. Comparison of sheet resistance and C/O ratio of other methods.

Reference	Sheet resistanc e Ω/square	C/O	Method
Nature Commun. **2010**, *1*, 73	~19.6 (~6.5 µm)	11.46	HI-AcOH, 40 °C, 40 h
Nature Commun. **2013**, *4*, 1539	~350 (Transpare ncy 80%)	16.61	Na-NH_3 solution at -78 °C

Nature Nanotech. **2008**, *3*, 270	~43000 (Transparency 63%)	-	GO film reduced with hydrazine vapor and annealed at 200 °C
Nature **2009**, *457*, 706	~280 (Transparency 80%)	-	CVD graphene film
Our result	**~130 (~4.2 μm)** **~5 (~10.8 μm)**	**16.2**	**GO film *in situ* reduction with sodium-benzophenone-hydrazine at room temperature**

References

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