

Supplementary Information

Transparent graphene films with tunable piezoresistive response

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I. Graphene oxide synthesis

GO was prepared from graphite (Bay-carbon, sp-1) via the Hummers method.^[1] All chemicals were used without any further purification. First, 23 mL of H₂SO₄ was added into a 250 mL 2-neck flask filled with graphite (0.5g) and NaNO₃ (0.5g) at ambient temperature. Next, 3 g of KMnO₄ was slowly added to the mixture to prevent abrupt reaction in an ice bath. The solution was stirred at 35°C for 2 hrs, and 40 mL of deionized water was slowly added and stirred for 1 hr while the reaction temperature was kept at 90 °C. Then, 100 mL of deionized water was added, and the solution was cooled to room temperature. Finally, the prepared graphite oxide was purified via filtration using a glass fiber membrane (pore size 1 μm), followed by rinsing with 1 wt% HCl and deionized water. The graphite oxide solution was centrifuged several times at 4,000 rpm for 10 min until the pH of the supernatant was nearly neutral.

II. Raman spectra of GO, Tr-GO and Hr-GO

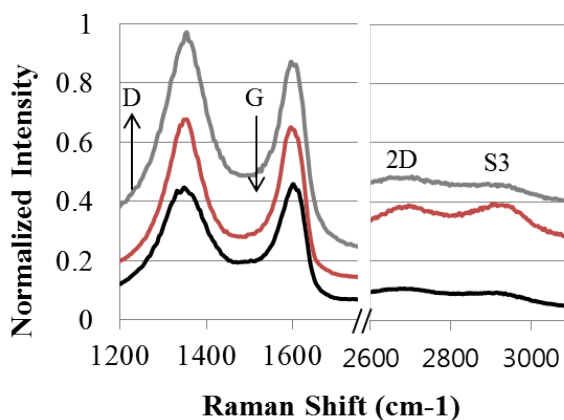


Fig. S1 Raman spectra of GO (black line) and rGO (Hr-GO; red line, Tr-GO; grey line) with different reduction methods. Raman spectrum for the as-deposited graphene oxide on SiO₂ substrate (black line) shows small shift of 2D band peak (from 2867 to 2872 cm⁻¹) and slightly increased I(D)/I(G) intensity ratio both from Hr-GO and Tr-GO. However, 2D band peak shift and I(D)/I(G) intensity ratio show thermal reduction is a more effective method for GO reduction. It is also evidenced from the resistivity measurement and is in good agreement with previous report.^[2]

III. XPS spectra of GO, Tr-GO and Hr-GO

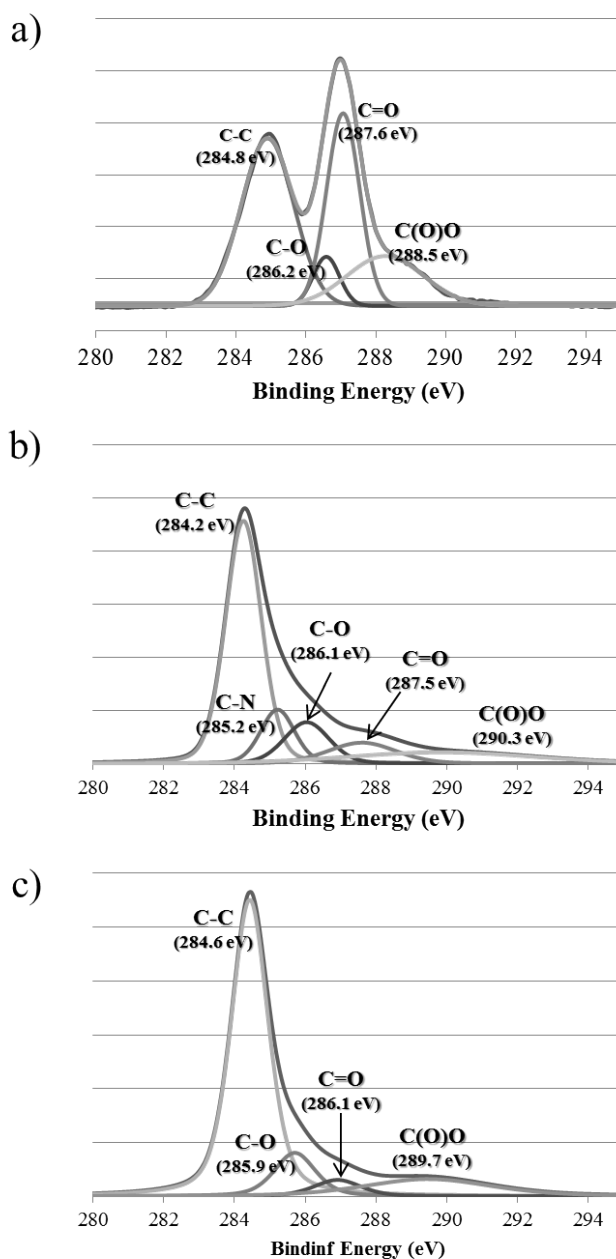


Fig. S2 Deconvoluted XPS spectra of the C1s region of (a) GO, (b) Hr-GO and (c) Tr-GO. A large oxidation degree of GO with four representative peaks that correspond to graphene with several functional groups is presented: C-C (284.6 eV), C-O (286.0 eV), C=O bonds (287.8 eV), and O-C=O (288.5 eV). In both cases, oxygen functional groups were still observed but their intensities much more decreased than those in GO. The apparent difference between Hr-GO and Tr-GO is the presence of a C-N bond (285.9 eV) observed in Figure S2(b). Only Hr-GO shows this peak, which is attributed to chemical reduction derived by hydrazine.

III. Thermogravimetric analysis of Tr-GO and Hr-GO

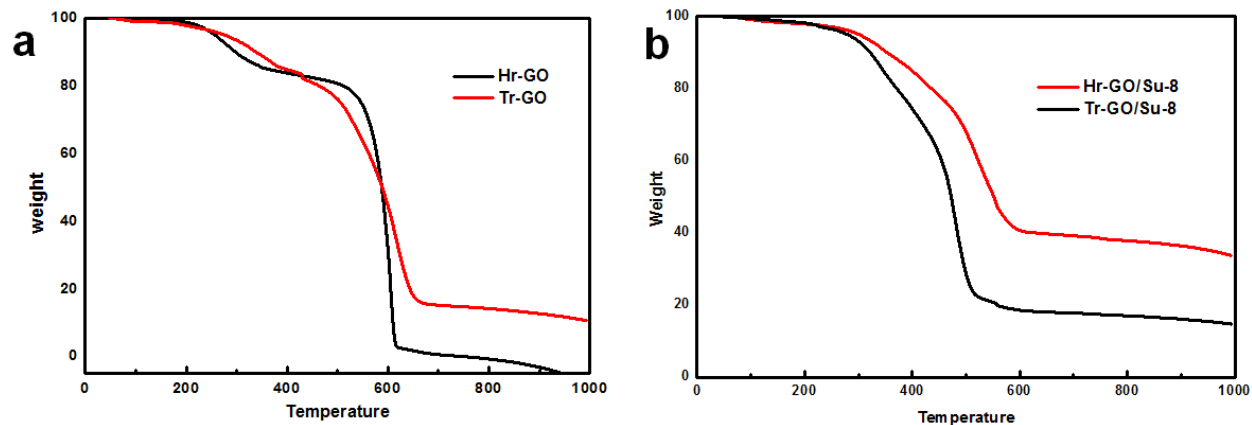


Fig. S3 Thermogravimetric analysis (TGA) of (a) Hr-GO and Tr-GO films and (b) Hr-GO/SU-8 and Tr-GO/SU-8 composite films. The higher onset temperature of degradation and greater thermal stability of Hr-GO/SU-8 than those of Tr-GO/SU-8 in (b) indicate the presence of strong chemical bonds between SU-8 and Hr-GO.

IV. Elemental analysis of GO, Tr-GO and Hr-GO

Table S1 Results from elemental analysis of GO, Hr-GO, and Tr-GO films.

	N	C	H	S	O
GO	0	61.28	1.36	2.40	29.42
Hr-GO	1.68	64.69	1.28	0	26.19
Tr-GO	0	74.59	0.20	0.48	4.49

V. UV-vis absorption spectra of GO, Tr-GO and Hr-GO

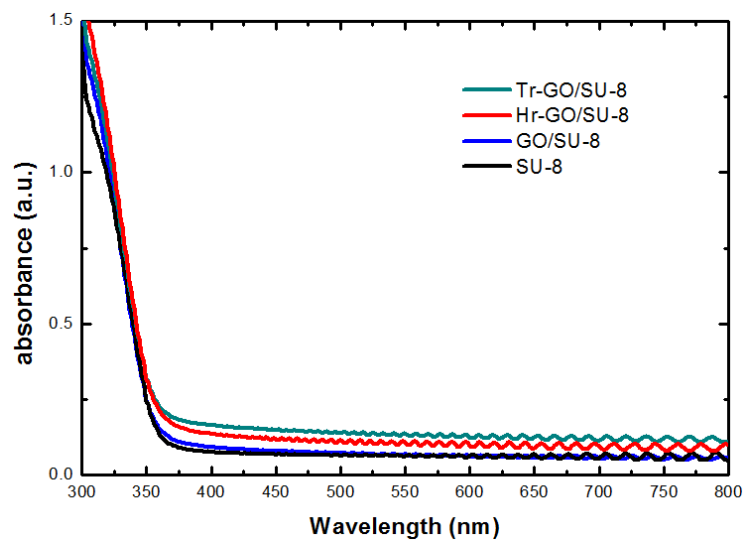


Fig. S4 UV-vis absorption spectra of SU-8, GO/SU-8, Hr-GO/SU-8, and Tr-GO/SU-8.

References for Supporting Information

- [1] W. S. Hummers, R. E. Offeman, *J. Am. Chem. Soc.* **1958**, *80*, 1339-1339.
- [2] D. Yang, A. Velamakanni, G. Bozoklu, S. Park, M. Stoller, R. D. Piner, S. Stankovich, I. Jung, D. A. Field, C. A. Ventrice Jr, R. S. Ruoff, *Carbon* **2009**, *47*, 145-152.