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Supplementary Information

Green preparation of high-quality and low-cost graphene with discarded polyethylene plastic bags

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1. Experimental

1.1 Materials and methods

In the experiment, the polyethylene (PE) plastic bags wastes were used as a precursor for the preparation of graphene, and the schematic representation is shown in Figure S1.

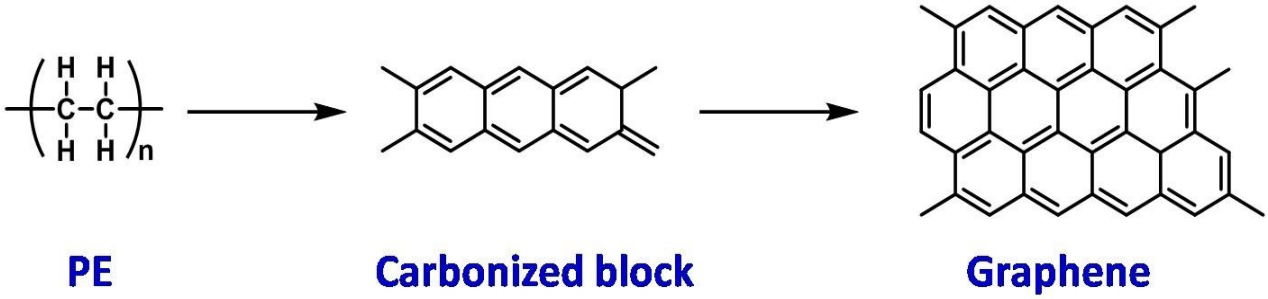


Figure S1 Schematic representation of preparation of graphene from PE plastic bags

The discarded PE plastic bags were first ultrasonic cleaned for 2h to remove surface contaminants, followed by cutting and ball milling for 6h. Then, about 2g of PE plastic bags tiny pieces of micron scale were sieved and carbonized at 1300^{o}C for 2h in vacuum oven, after that the carbonized block was ball milled with 7500rmp in order to get the carbonized powders, which were further washed, purified and microwave sintered for 6min. Finally, the black products were purified again and vacuum dried to obtain the graphene, as illustrated in Figure S2. Figure S3 shows the photo of the as-prepared graphene from PE plastic bags.

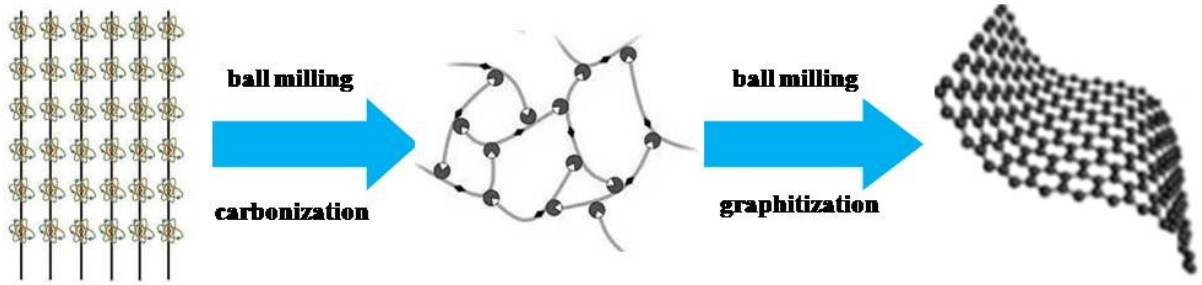
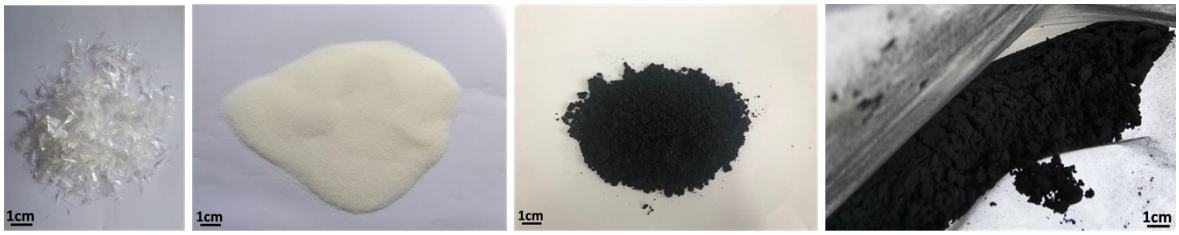


Figure S2 The preparation process of graphene from PE plastic bags



after cutting after ball milling after carbonizing as-prepared graphene

Figure S3 Pictures of (left to right) PE plastic bags after cutting; after ball milling; after carbonizing; and as-prepared graphene

1.2 Instrumental characterization

Raman spectra were performed by an inVia laser confocal Raman spectrometer which equipped with a 532nm laser source. The crystallographic structure of graphene samples was performed with an Apex II X-ray diffractometer (XRD). X-Ray photoelectron spectroscopy (XPS) data deposited on glass substrates were measured by a Quantera spectrometer with a monochromatized Al Ka X-ray source (1486.71eV) for determining the compositions and chemical bonding configurations. Before the XPS measurement, as-prepared graphene sample was first put into the electronic moisture-proof tank for 24h under RH=10% and T=20^0C atmosphere to remove the moisture on its surface, and then the sample was completely removed the adsorbed water under ultra high vacuum (UHV) condition. The morphology was observed by FEI-Quanta 650 Scanning electron microscopy (SEM). Transmission electron microscope (TEM) images were recorded on Tecnai G20S-Twin system operating at 200kV. The specimens were prepared by drop-casting the sample solution onto an ultrathin carbon coated copper grid, followed by drying at room temperature. The N_2 adsorption and desorption isotherms were measured at 77K on a V-Sorb 2800S gas adsorption-desorption apparatus. The specific surface area (SSA) was calculated using the Braunauer-Emmett-Teller (BET) method, and the relative pressure range of P/P_0 from 0.1 to 0.3 was used for multipoint BET calculations. The electrical conductivity of graphene was measured with a Tongchuang SZT-2 Test Unit based on a four-point-probe head with a pin-distance of about 1mm, Electrical conductivity at ambient temperatures was measured inside a variable temperature insert (VTI).

2. Results and Discussions

2.1 XRD pattern

Figure S4 shows the XRD pattern of as-prepared graphene.

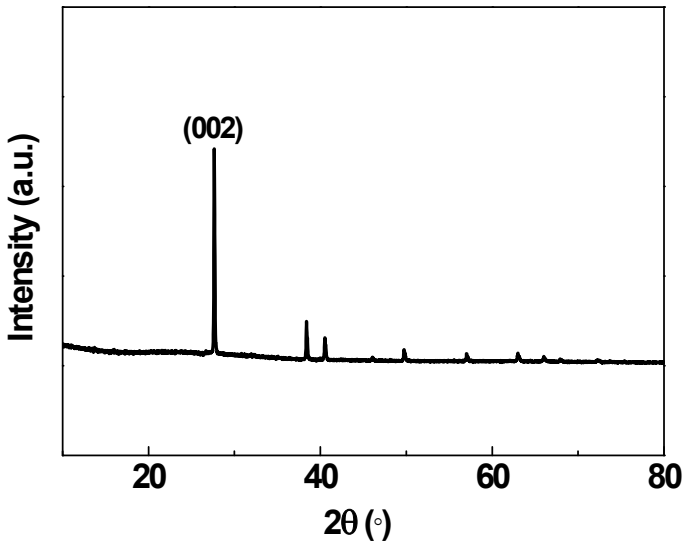


Figure S4 XRD spectrum of as-prepared graphene

One strong diffraction peak at 2θ=26° corresponding to the (002) plane of graphitic carbon (JCPDS 01-075-1621) demonstrates that the as-prepared graphene has high degree of crystallinity, which is similar with XRD pattern of graphene prepared with chemical vapor deposition process and different from that of graphene prepared with REDOX method [1].

2.2 XPS spectrum

Table S1 Element compositions obtained from XPS analysis

Sample	C (at.%)	O (at.%)	Others (at.%)
graphene	98.08	1.80	0.12

2. 3 SSA test

Table S2 The test SSA of as-prepared graphene

Slope	Intercept	Adsorption constant	R^2	BET SSA ($m^2 \cdot g^{-1}$)
0.00986	0.00016	468.5	0.9999	1521.3

In comparison, there have been several reports on specific surface area of graphene, and a few typical examples were listed in Figure S5 [2-7]. Although the theoretical SSA of graphene is 2630$m^2 \cdot g^{-1}$, the SSA of prepared graphene samples (as mentioned in Figure S5) is ranging from ~300 to ~1000$m^2 \cdot g^{-1}$, which is much lower than that of our work.

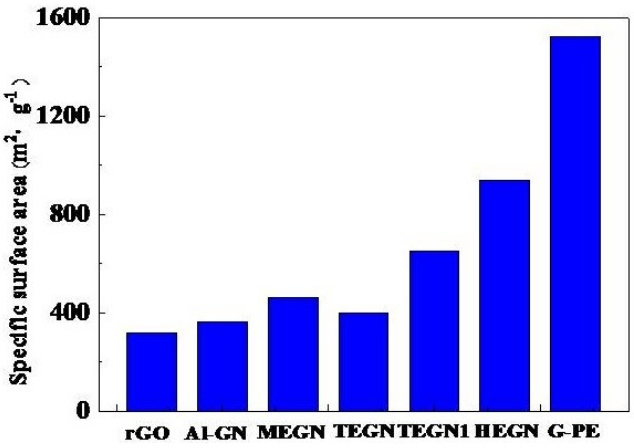


Figure S5 Comparison of SSA for typical graphene examples
rGO[2], Al-GN[3], MEGN[4], TEGN[5], TEGN1[6], HEGN[7], G-PE[our work]

Supporting References

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