Chemical reactivity of C-F bonds attached to graphene with diamines depending on its nature and location

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Supporting Information

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1.1 Characterization

Scanning electron microscope (SEM) was operated with FEI Inspect F (FEI Company, USA) at 20 kV and the magnification was set at 20,000×. To measure the distribution of various elements, the elemental mapping was performed using an energy dispersive X-ray spectroscopy (EDX) analyzer (Oxford instruments).

Atomic Force Microscopy (AFM) was performed on a MFP-3D-SA (Asylum Research) in tapping mode. The samples for AFM images were prepared by depositing a dispersed ethanol solution (0.1 mg/mL) onto a clean silicon substrate and allowing them to dry at 80 °C for 10 h under vacuum.

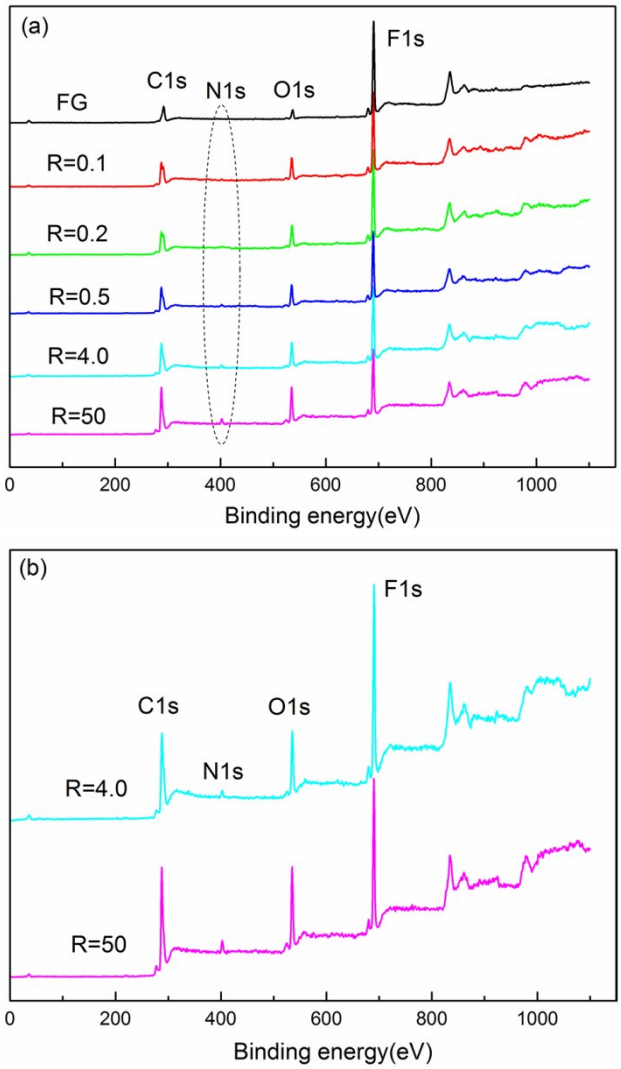

Fig.1s The full survey XPS spectra of FG and various PEA-FG products.

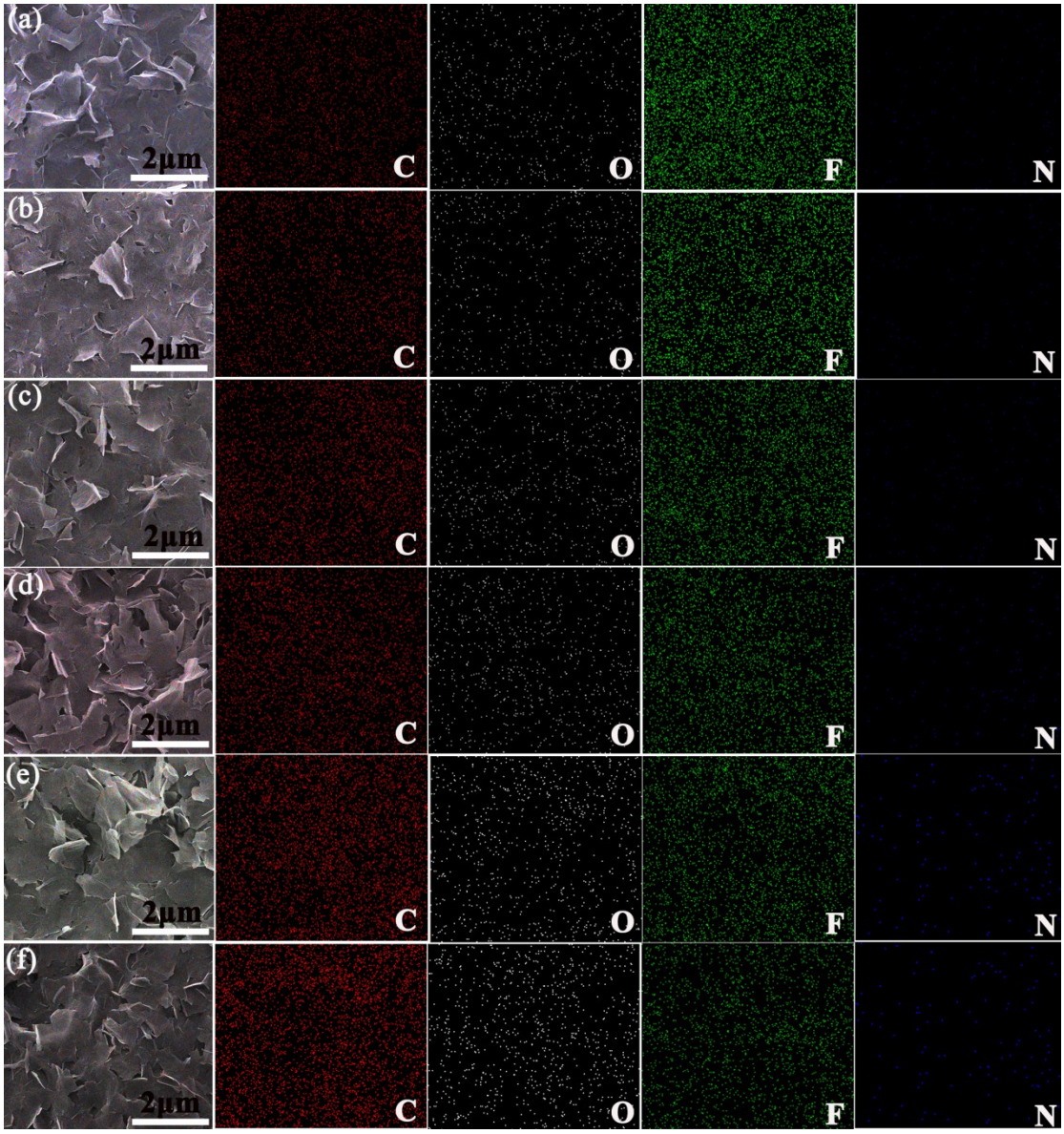

Fig. 2s SEM images and EDX cartography of FG and various PEA-FG products. Attribution to C, O, F and N elements is indicated at the left top corner of each cartography picture.

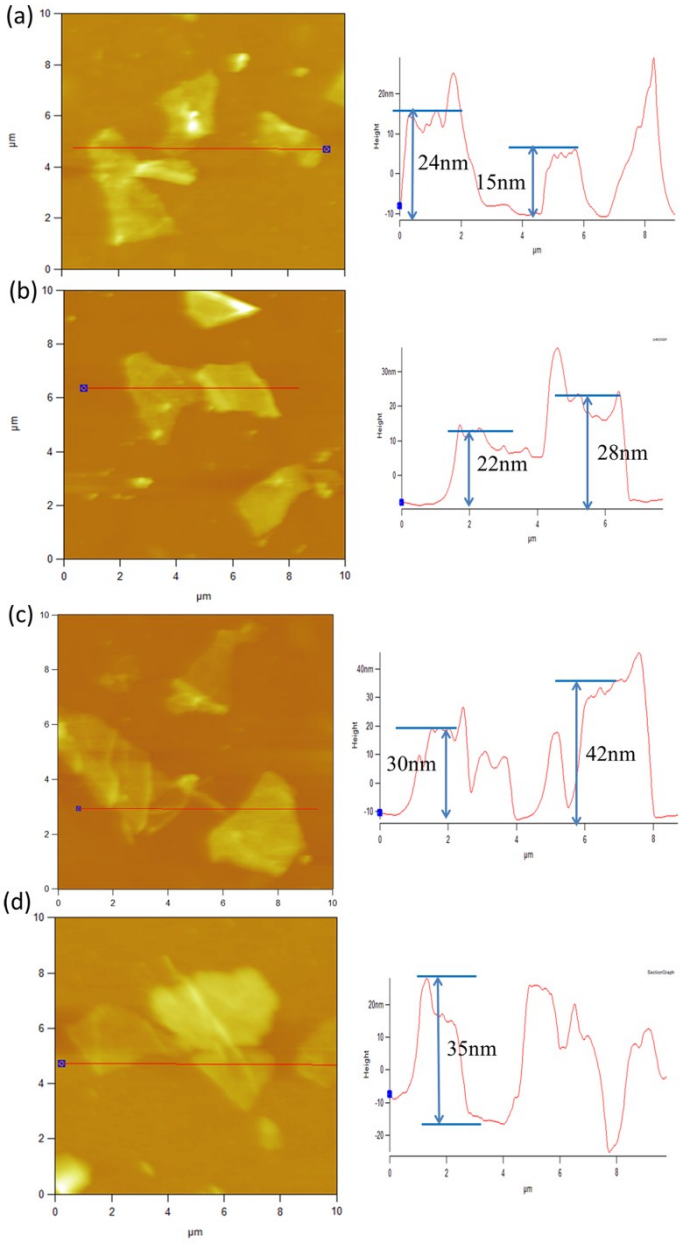

Fig. 3s AFM images of FG and various PEA-FG products with the corresponding height profiles, (a) FG, (b) R=0.5, (c) R=4.0 and (d) R=50.

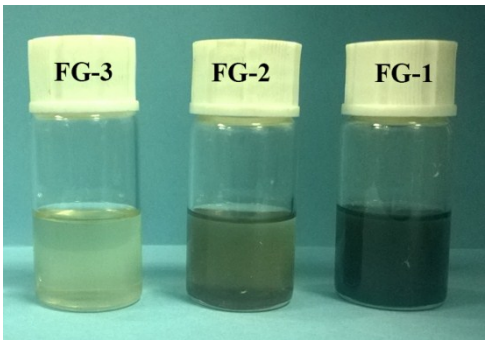

Fig. 4s The color of the samples changes gradually from white to gray to black for FG1.FG2 and FG3.

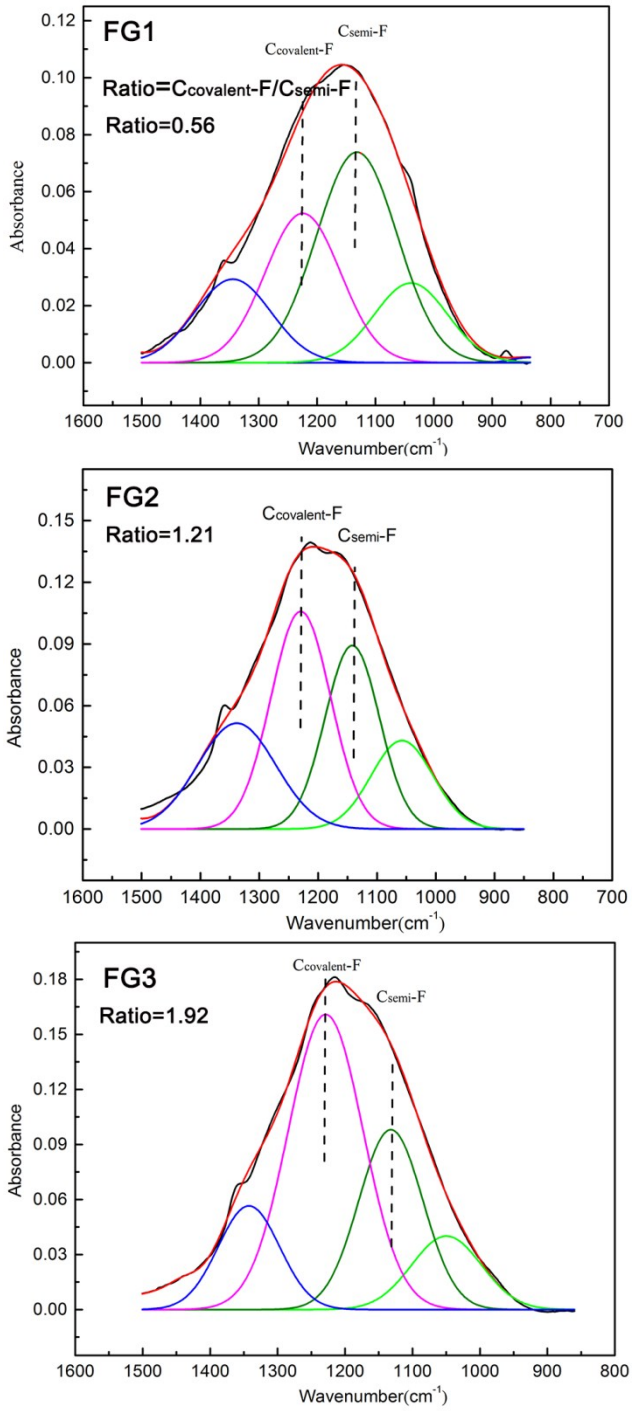

Fig. 5s The ratio of $C_{covalent}$-F/C_{semi}-F (by area in the absorption peak) observed in ATR-FTIR spectra of FGs at 1600-800 cm^{-1}.

Table 1s The assignment of peaks for FG and various PEA-FG products in the C 1s spectra

Bond type	C=C (%)	C_{semi}-F (%)	$C_{covalent}$-F (%)	-CF_2 (%)	-CF_3 (%)
FG	8.8	14.4	33.7	14.0	2.7
R=0.1	14.7	12.5	29.1	12.4	2.9
R=0.2	18.2	11.3	25.5	12.8	2.7
R=0.5	23.9	9.3	18.4	10.5	2.6
R=4.0	27.2	7.4	13.9	9.6	2.9
R=50	34.1	6.6	9.7	8.2	2.1

Table 2s The chemical composition of FG with the increasing of F/C ratio.

Samples	C(at%)	N(at%)	O(at%)	F(at%)	**F/C**
FG1	61.71	0.63	12.18	25.48	0.41
FG2	52.59	0.54	10.65	36.22	0.68
FG3	50.60	0.51	9.11	39.78	0.79

Table 3s The chemical composition of FG and various graphene derivatives based on XPS calculation

Samples	C(at%)	N(at%)	O(at%)	F(at%)	Formula 1
PEA-FG1	72.96	1.18	14.95	10.91	$C_1(PEA\text{-}D230)_{0.004}N_{0.009}O_{0.204}F_{0.146}$
PEA-FG2	66.56	2.95	15.55	14.94	$C_1(PEA\text{-}D230)_{0.023}N_{0.010}O_{0.233}F_{0.224}$
PEA-FG3	60.87	3.68	14.22	21.23	$C_1(PEA\text{-}D230)_{0.036}N_{0.012}O_{0.234}F_{0.490}$