Electronic Supplementary Material (ESI) for RSC Advances.

Supporting information

Introduction of holes into graphene sheets to further enhance graphene-TiO_2 photocatalysis activities

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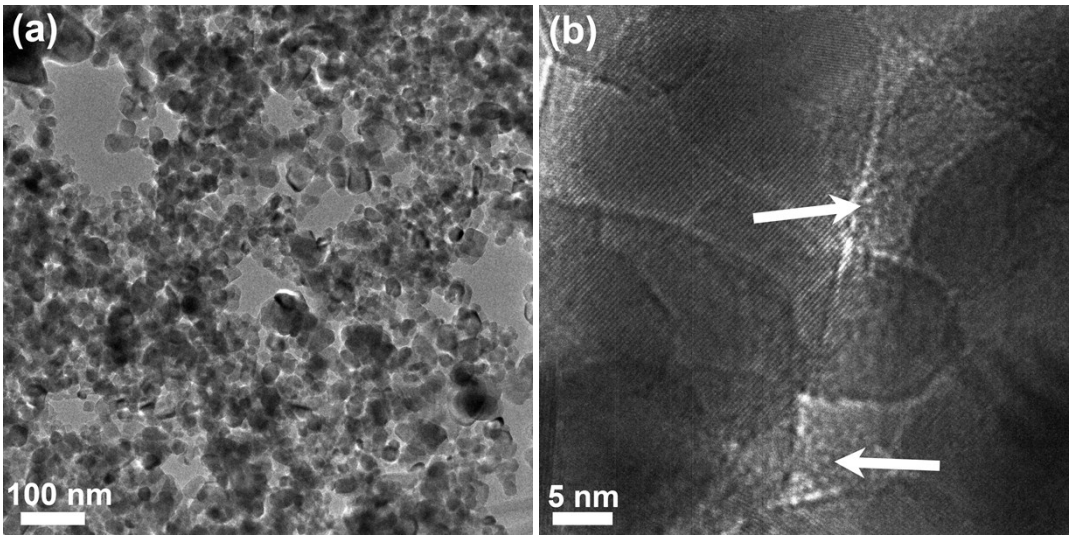

Fig. S1. Typical TEM images of $HGT_{30.0\%}$ samples. After treated by excess H_2O_2, carbon sheets are damaged seriously, and large defects can be clearly seen in these carbon sheets, except for small nanopores shown in (b).

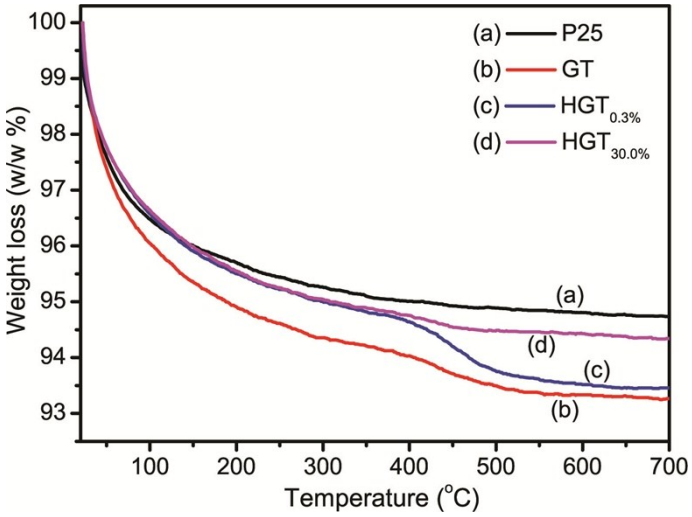

Fig. S2. TG analysis of (a) P25, (b)GT, (c)$HGT_{0.3\%}$ and (d) $HGT_{30.0\%}$ samples. The original dosages of GO sheets in graphene-involved samples are almost same (1 wt %). The actual content of reduce GO (RGO) sheets in $HGT_{x\%}$ decreased after etched by H_2O_2. Meanwhile, the more dosage of H_2O_2 used, the less the content of RGO remained.

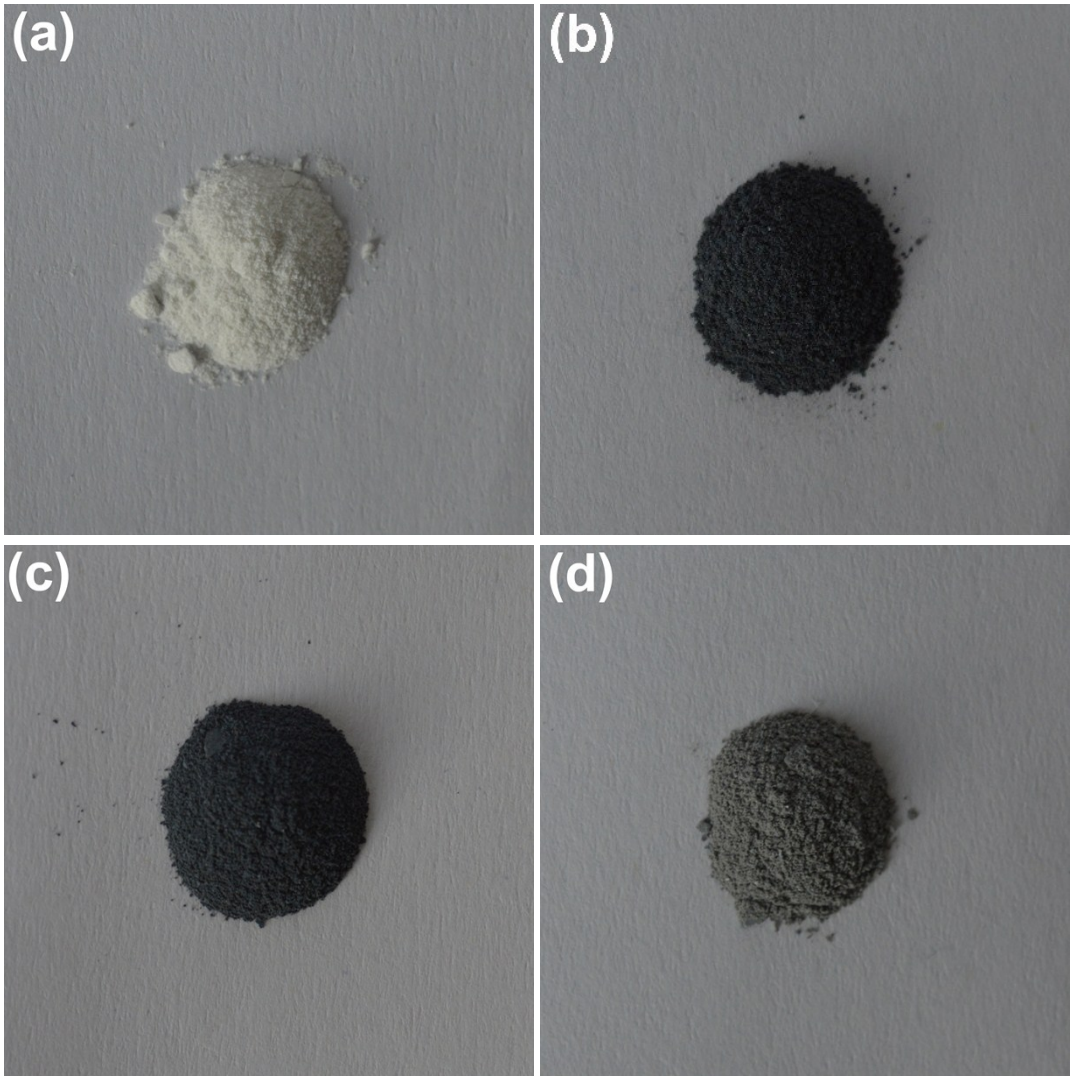

Fig. S3. Digital photos of of (a) P25, (b) GT, (c) $HGT_{0.3\%}$ and (d) $HGT_{30.0\%}$ samples. After combined with RGO, the color of GT turns black (b). However, the color of $HGT_{x\%}$ is bleached compared with that of the traditional GT ones. Practically, due to the serious etching, the content of RGO in $HGT_{30.0\%}$ loses obviously, so the color of as-obtained composites becomes pale grays (d).

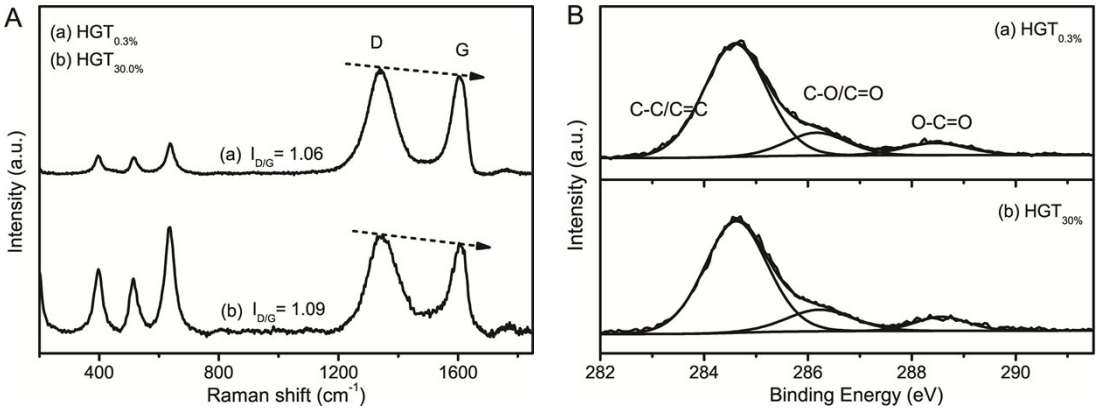

Fig. S4. (A) Raman and (B) XPS spectra of (a) $HGT_{0.3\%}$ and (b) $HGT_{30.0\%}$ samples. As Raman results shown in (A), when high concentration H_2O_2 is used, the anabatic etching reaction may form more defects and/or disorders in carbon sheets, which leads to the increases in $I_{D/G}$ rate. However, the reduction degree of GO sheets in $HGT_{x\%}$ is not affected obviously by these additional H_2O_2 reagent (B).

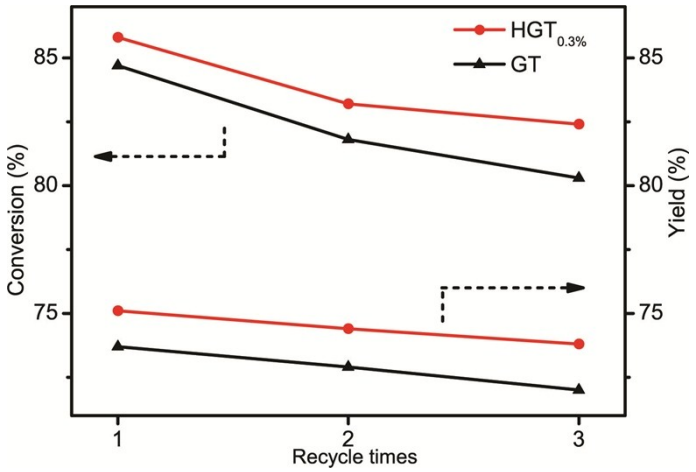

Fig. S5. Recycle experiments of $HGT_{0.3\%}$ and GT composites on photo-reduction of 4-nitrophenol. The activity of these composites decreases mildly after every recycle experiment, which is probably due to the wastage of the catalysts. It is noted that $HGT_{0.3\%}$ samples always exhibit the relatively higher properties compared with that of GT catalysts.

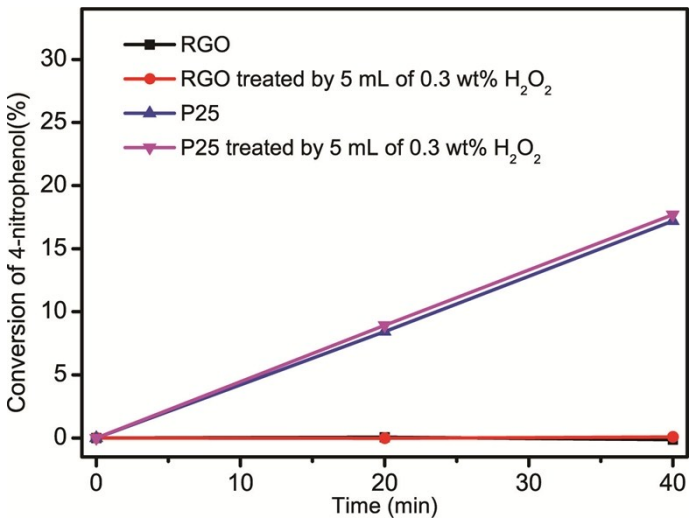

Fig. S6. Conversion of 4-nitrophenol plotted as a function of irradiation time using RGO, RGO treated by H_2O_2, pure P25 and P25 treated by H_2O_2 as catalysts, respectively.

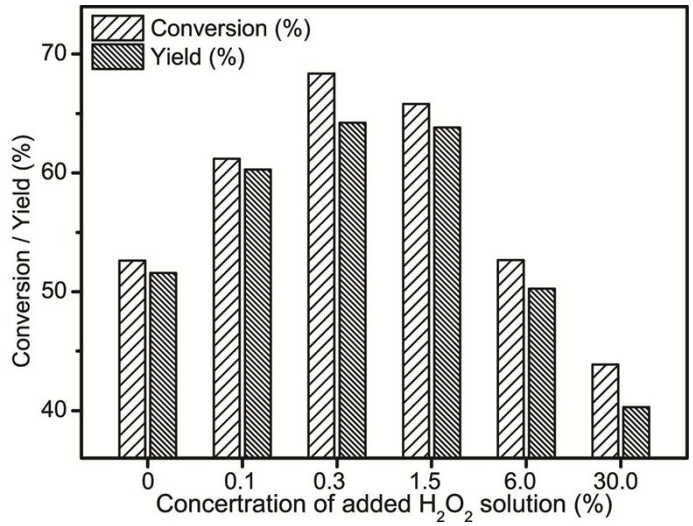

Fig. S7. Photoreduction of 4-nitrophenol into 4-aminophenol of graphene-involved samples under UV light irradiation for 40 min. The original usages of GO sheets in these graphene-involved composites are about 0.75 wt%.

Table 1S. XPS data of C1s of GO and its derivatives. The corresponding binding energies (eV) and area percentages of deconvoluted peaks (%, in parentheses) are listed in the table.

Samples	Functional Groups		
	C-C	C-O/C=O	O-C=O
GO-TiO_2	284.6 (62.1)	286.2 (27.7)	288.2 (10.2)
GT	284.6 (79.5)	286.3 (12.1)	288.3 (8.4)
$HGT_{0.3\%}$	284.6 (75.5)	286.2 (16.0)	288.4 (8.5)
$HGT_{30.0\%}$	284.6 (75.6)	286.2 (16.6)	288.6 (7.8)