Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics.

Supporting Information for

Thickness-dependent photocatalytic performance of graphite oxide for degrading organic pollutants under visible light

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Experimental

Measurement of photocatalytic degradation of methyl orange

The photocatalytic degradation of methyl orange dyes was performed in aqueous solutions at ambient temperature. Twenty mg of the sample (GO, **Stirred-GO**, **Sonic-GO-1, and Sonic-GO-2**) was placed in a quartz beaker (100 mL). Then, an aqueous solution of methyl orange was added to the quartz beaker. The mixture was stirred in the dark until reaching adsorption-desorption equilibrium. The reaction mixtures were irradiated by visible light produced using a 150 W solar simulator (LS-150-Xe, Abet Technologies, Inc., Milford, CT) with an AM1.5G and a cutoff filter (GG420 long pass filter, Edmund Optics and KG-3 heat absorption filter, Schott). After irradiation for 10 min, the methyl orange solution (2 mL) was decanted and filtered using a 0.45 μm syringe filter. Then absorption spectra of the methyl orange solutions were obtained using a UV-vis spectrophotometer (UV-2600, Shimadzu, Japan).

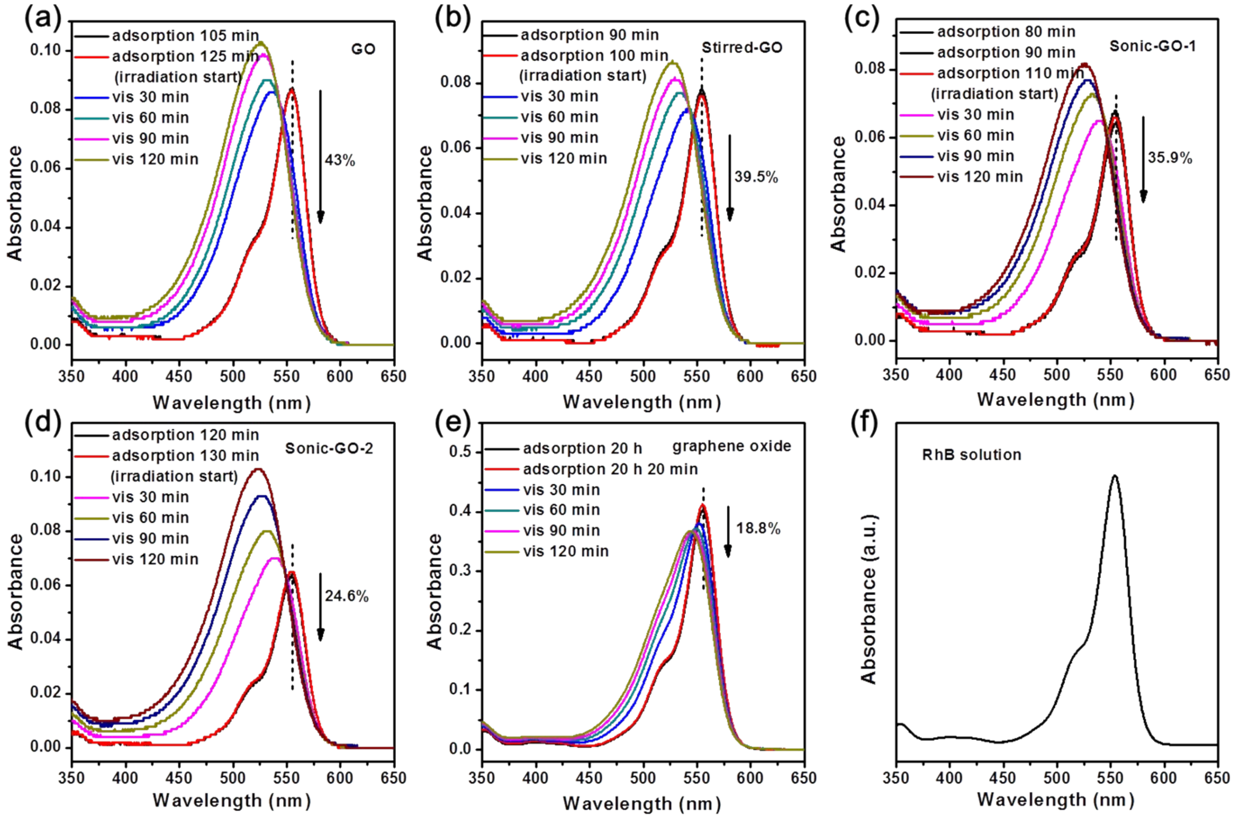

Fig. S1 The UV-vis absorption spectra of RhB solutions after reaction with (a) GO, (b) **Stirred-GO**, (c) **Sonic-GO-1**, (d) **Sonic-GO-2**, and (e) G-O samples, and (f) without any samples under irradiation of visible light.

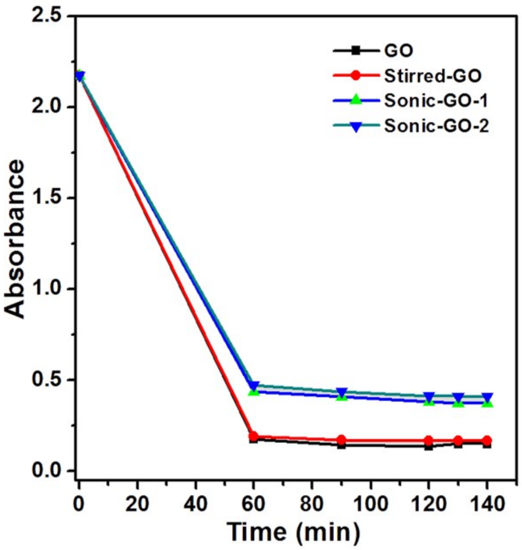

Fig. S2 Adsorption-desorption equilibrium curves of RhB under dark in the presence of GO-based photocatalysts.

This figure shows that adsorption-desorption dynamics between RhB and GO-based materials in water reached the equilibrium after 60 min under dark. Visible light was irradiated to the samples after reaching the equilibrium to exclude possible adsorption effect of RhB on the GO-based materials.

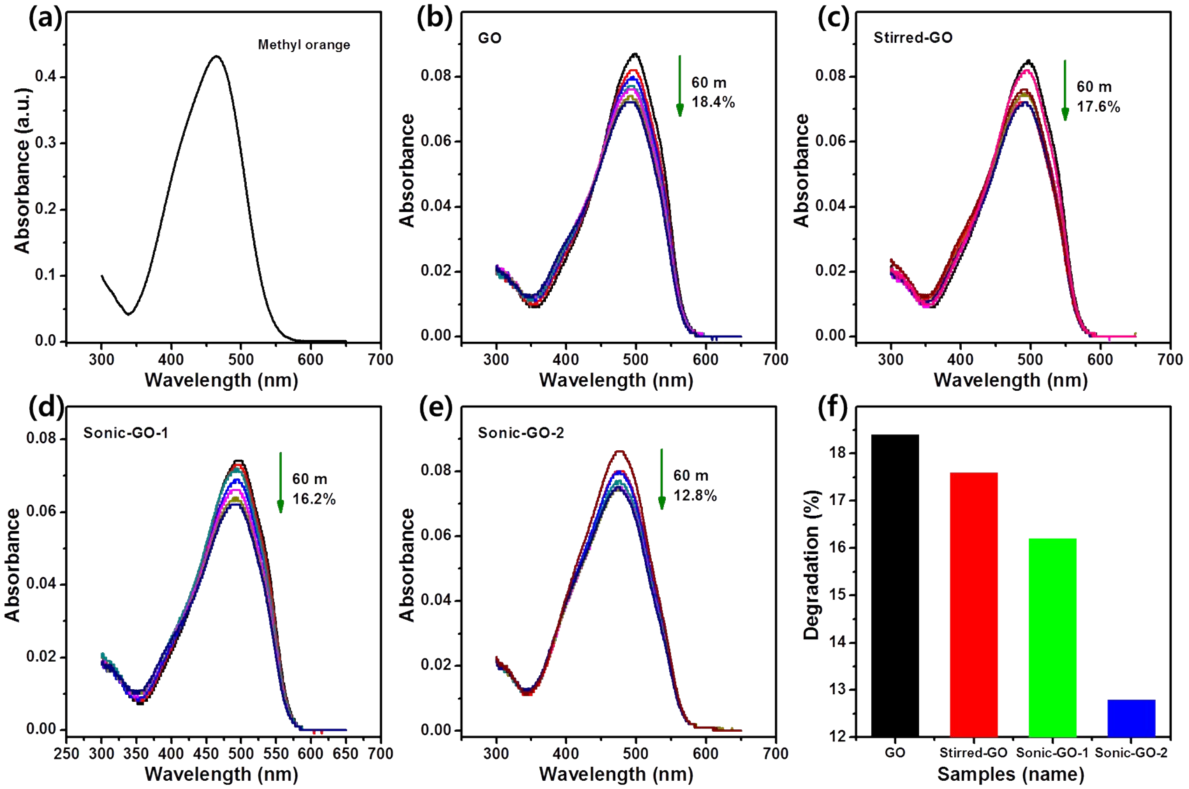

Fig. S3 The UV-vis absorption spectra of (a) an UV-vis absorption spectrum of a pure methyl orange solution and of methyl orange solutions in water with (b) GO, (c) **Stirred-GO**, (d) **Sonic-GO-1**, and (e) **Sonic-GO-2** under visible light irradiation as a variation of time. (f) Comparison of catalytic activity for degrading methyl orange between GO-based materials.

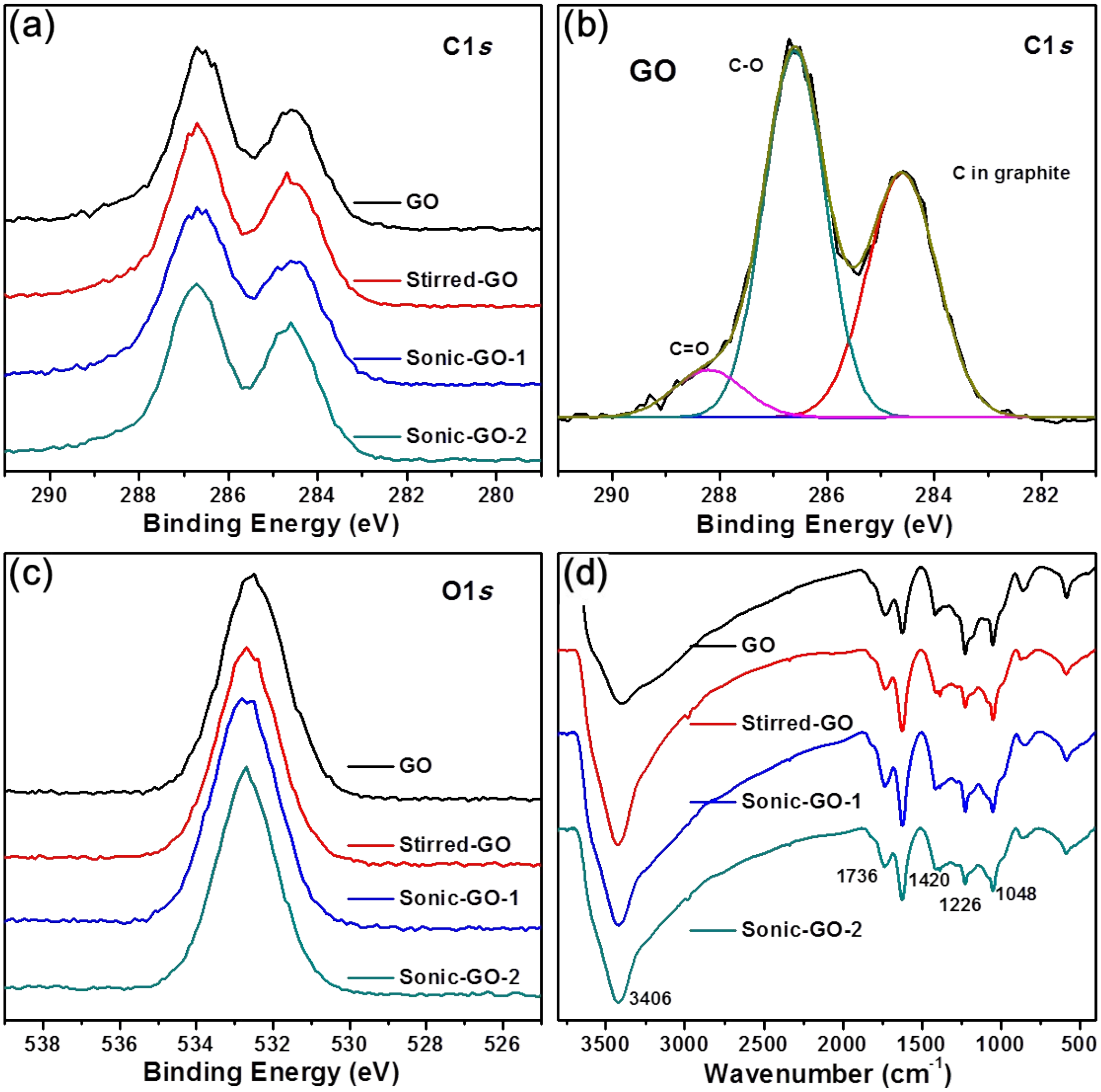

Fig. S4 Chemical characterizations of the GO, **Stirred-GO**, **Sonic-GO-1**, and **Sonic-GO-2** samples: a) XPS C1*s* spectra; b) XPS C1*s* spectrum of GO including deconvolution; c) XPS O1*s* spectra; d) FT-IR spectra.

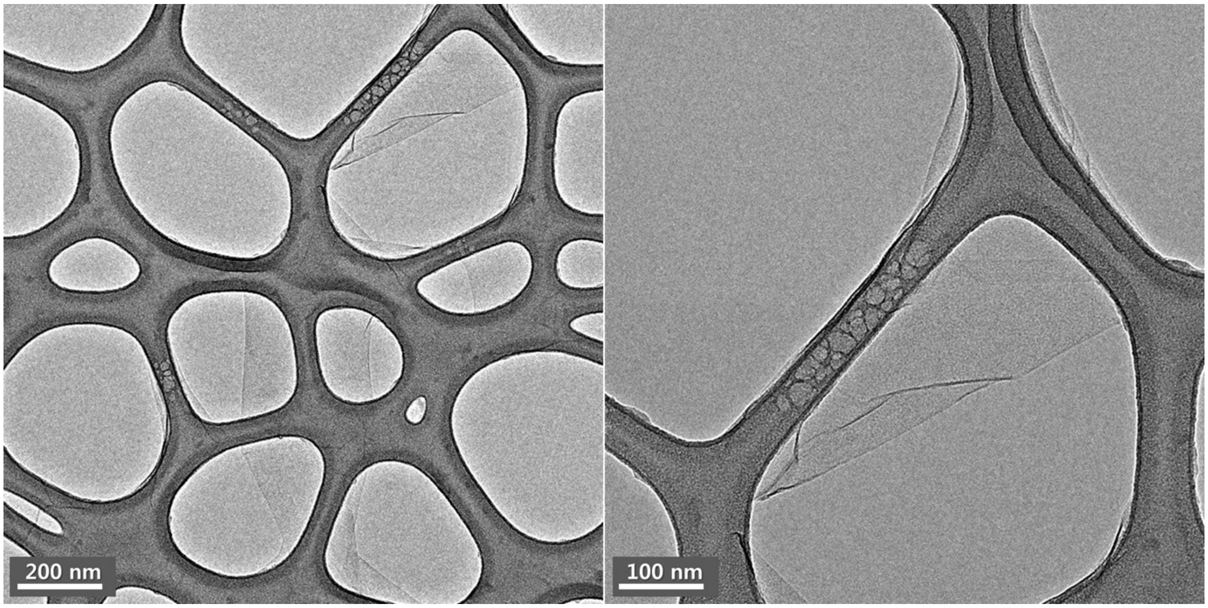

Fig. S5 TEM images of single layer graphene oxide.

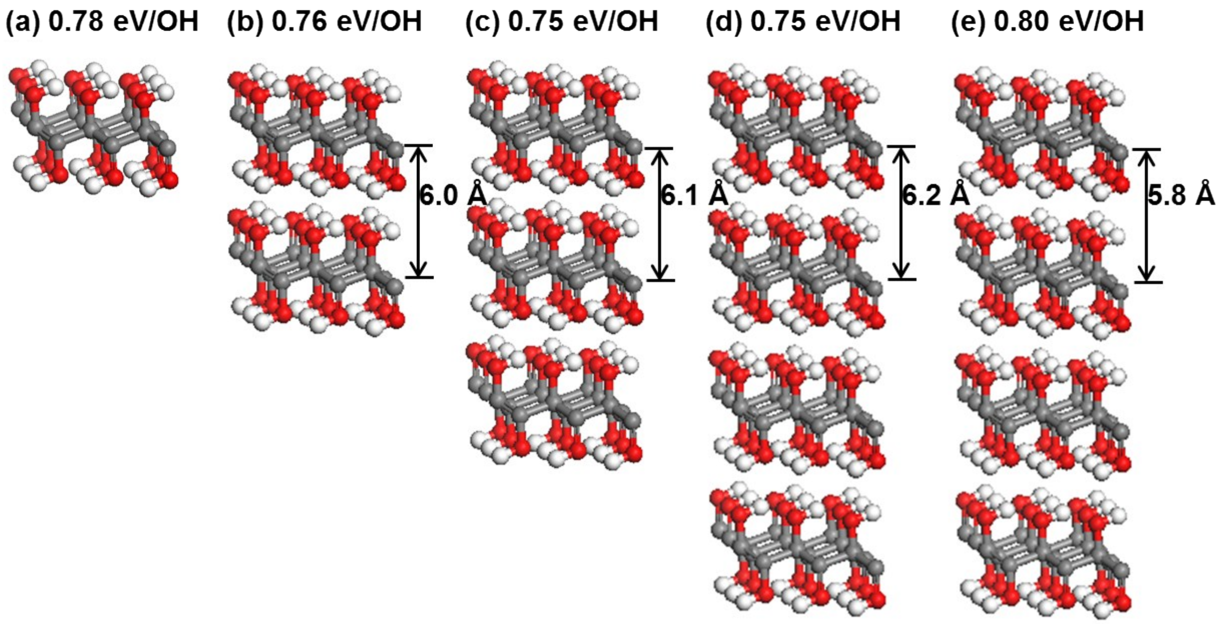

Fig. S6. Atomic structures of (a) graphene oxide (G-O) with 1 ML hydroxyl oxygen, (b) 2 layer G-O, (c) 3 layer G-O, (d) 4 layer G-O and (e) graphite oxides (GO) of AA stacking. The gray, red and white balls represent C, O and H atoms, respectively. The formation energy per OH molecule is presented in each configurations. Their formation energies are not significantly changed as increasing number of layers. The interlayer distances are almost same at graphene oxides of (b) 6.0 Å, (c) 6.1 Å and (d) 6.2 Å, but in the case of graphite oxides the interlayer distances are slightly reduced to (e) 5.8 Å.

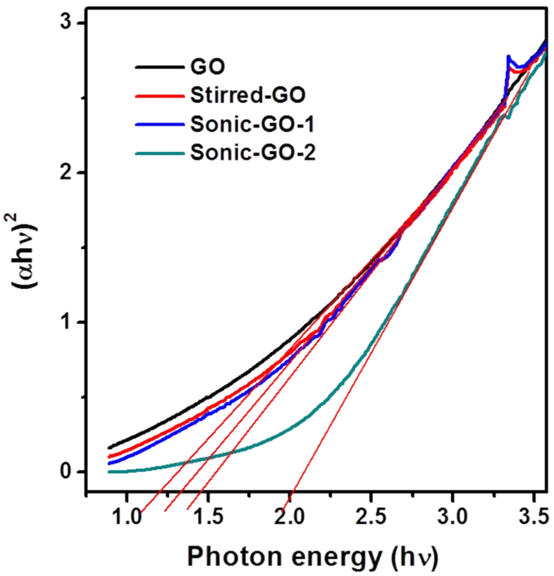

Fig. S7 Kubelka-Munk plots and band gap energy estimation of GO (1.18 eV), **Stirred-GO** (1.32 eV), **Sonic-GO-1** (1.45 eV), and **Sonic-GO-2** (2.00 eV).

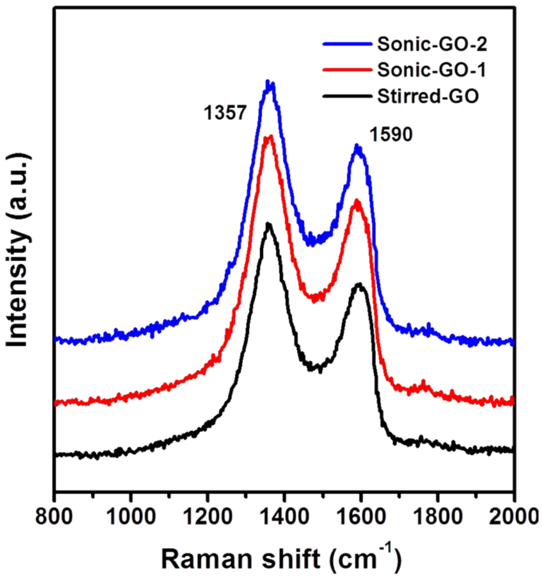

Fig. S8 Raman spectra of **Stirred-GO**, **Sonic-GO-1**, and **Sonic-GO-2** samples.

Raman spectra of GO-based materials show two broad peaks, D and G bands at 1367 and 1590 cm^{-1} respectively, which is typically observed in Raman measurements of GO-based materials. Their D/G ratios are similar each other in the range between 1.32 and 1.35. It suggests that structures and domain size associated with sp^2 network are not changed by stirring and sonication.

Table S1. Comparison of photocatalytic performances of previously reported GO-based hybrid catalysts and the GO materials used in this work.

Journal	Photocatalyst	Sample (mg)	RhB Con.	Lamp power (W)	Cut-off	Time (min)	Deg.(%)	Ref.
-	Graphite oxide (GO)	20	5.94 x 10-5 M	150	420 nm long pass with heat (IR) absorption filter	120	43	This work
Nanotechnology 2014, 25, 445404	CdS·poly(isoprene-b-acrylic acid)	13	10-5 M, 2.5 mL	500	1M NaNO2	150	45	1
	CdS·poly(isoprene-b-acrylic acid) +graphene						90	
Environ. Sci. Technol. 2011, 45, 5731–5736	Ag@AgCl/RGO	50	10 mg/L, 50 mL	350	>400 nm	16	95	2
Carbon 2014, 66, 119-125	graphene-C3N4	30	2x10-5 mol/L	150	One solar light	60	35	3
Appl. Surf. Sci. 2014, 258, 2473-2478	CdS/graphene	20	1x10-5 mol/L, 50 mL	500	-	80	95	4
Phys. Chem. Chem. Phys. 2012, 14, 15657-15665	Ag3PO4/GO	35	8 mg/L, 100 mL	500	>420 nm	22	100	5