Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics

Supplementary Information

Photoinduced charge transfer composite of graphene oxide and ferrocene

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Materials and methods

Synthesis of graphene oxide (GO)

Pure graphite sheet (99.9 %) was oxidized with modified Hummers method.[39] with a controlled manner. The reaction was started putting 2 gm small pieces of graphite in 150 mL sulfuric acid (98.08 H_2SO_4, Wako chemicals) and stirred vigorously in a magnetic stirrer at ice bath. 1.5 gm Sodium Nitrate (99.9 % $NaNO_3$, Wako chemicals) was added to the reaction as stirring continues. After sometime of stirring 12 gm of $KMnO_4$ was added slowly to the reaction. The reaction was carried out for two days under vigorous stirring at room temperature (25 ºC). Then the solution was diluted with 300 mL H_2SO_4 and water (1:2) mixture. 50 mL of Hydrogen Peroxide (30 % H_2O_2, Waco chemicals) solution was added slowly to the diluted solution to obtain a brown color product. After two hours of reaction the product was filtered out and impurity removal experiments were carried out. To remove the inorganic anions, the product was treated with hydrochloric acid (37 %, HCl, Wako chemicals) and followed by de-ionized water for several cycles. Then the product was dried overnight at 70 ^{O}C in an oven. As synthesized GO is almost insulating, hence it was partially reduced by annealing at 150 ^{0}C in hydrogen atmosphere. The final product was dispersed in water and ethanol (99.5 %, Wako chemicals) and thin films were fabricated on different substrates by drop

casting or spin coating for experimental studies. In the figure S1(a) & (b) GO solution in ethanol dispersion and a drop casted transparent film on glass substrate is presented.

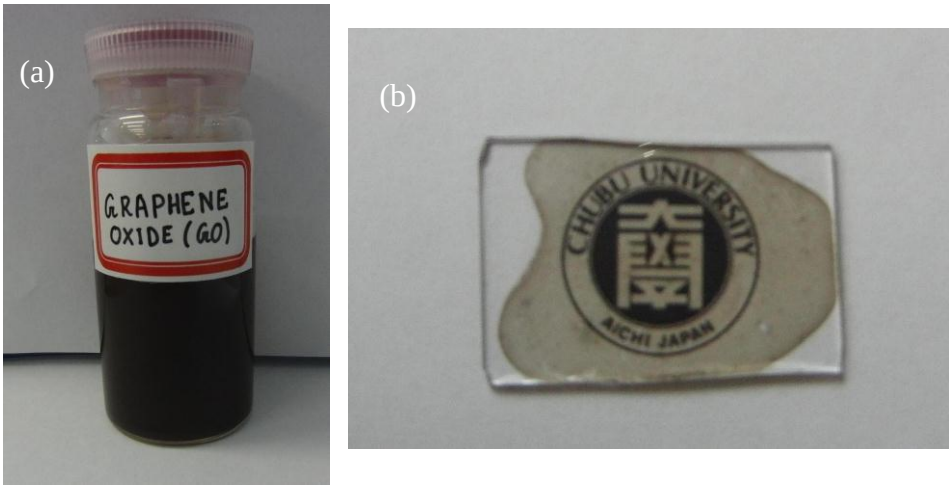

Figure S1 (a) well dispersed graphene oxide (GO) solution in ethanol (b) a thin film fabricated on glass substrate by drop casting.

X-ray photoelectron spectroscopy of GO and partially reduced GO.

The as synthesized and partially reduced GO was characterized with XPS analysis as shown in the figure S2. The wide XPS spectrum of the GO and partially reduced GO shows presence of carbon, oxygen and small amount of sulfur. The C1s peak significantly enhanced and O1s peak reduced with partial reduction of the GO sample by annealing in H_2 atmosphere. Figure 2S(b) and (c) show the de-convoluted C1s peaks for as synthesized and partially reduced GO, respectively, with typical C–O and C=O peaks at higher binding energies (285.42 and 287.63 eV). With partial reduction, the C=O peaks reduced and C-C peak (284.04 eV) gets enhanced, which indicates increase

in sp^2 bonded carbon with reduction of oxygen containing groups. The partially reduced graphene was used to fabricate the composite with ferrocene molecules.

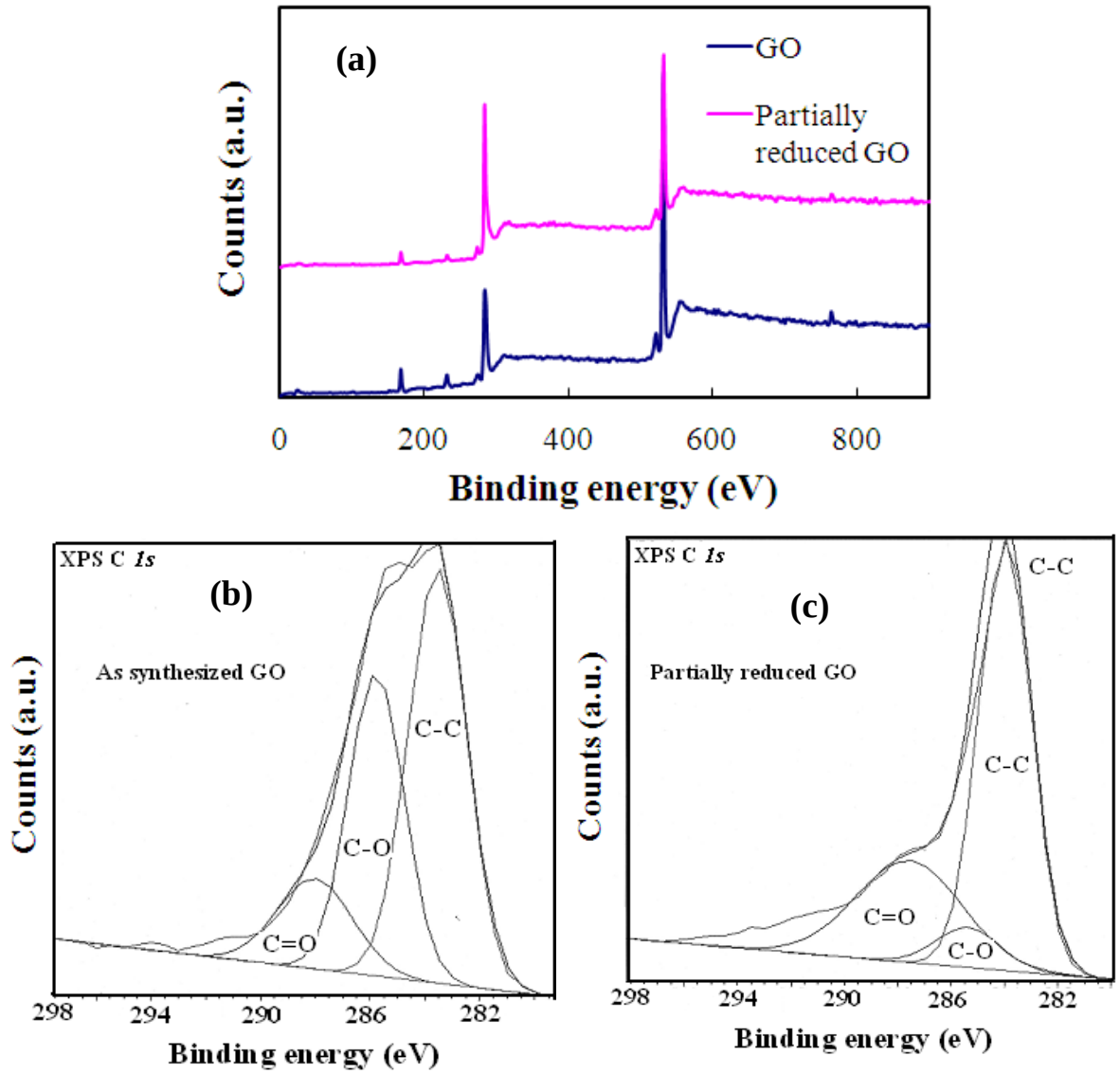

Figure S2 (a) wide XPS spectra of as synthesized and partially reduced GO, (b) C1s XPS spectra of as synthesized GO and (b) pr-GO films. The binding energies 284.04, 285.42 and 287.63, eV corresponds to C-C, C-O and C=O, respectively.