

Supporting Information Available

Graphene/porous cobalt nanocomposite and its noticeable electrochemical hydrogen storage ability at room temperature

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Experimental section

XRD analyses were performed on a X'Pert Pro diffractometer with Cu K α radiation (λ = 1.54 Å). The surface morphology of the samples was observed on a scanning electron microscopy (JEOL-JSM-6700F) and a transmission electron microscopy (JEOL 2010). BET surface area and pore volume were tested with a Quantachrome Instruments NOVA4000 after the samples were vacuum dried at 300 °C over 10 h. Raman spectra were collected with a JY-HR800 Raman spectrometer (JY Co., France) with an excitation beam wavelength at 532 nm. X-ray photoelectron spectroscopy (XPS) measurements were carried out using a spectrometer with Mg K α radiation (ESCALAB 250, Thermofisher Co.). The binding energy was calibrated with the C 1s position of contaminant carbon in the vacuum chamber of the XPS instrument (284.8 eV).

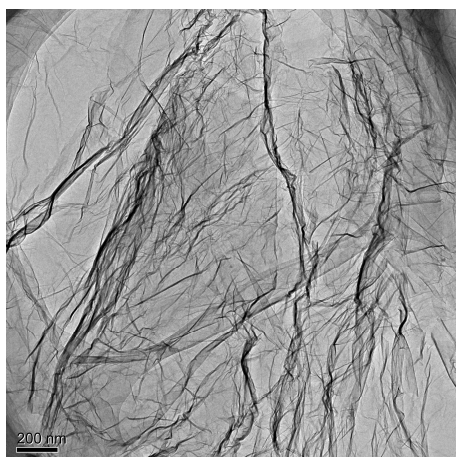


Figure S1 TEM image of graphene used in this work

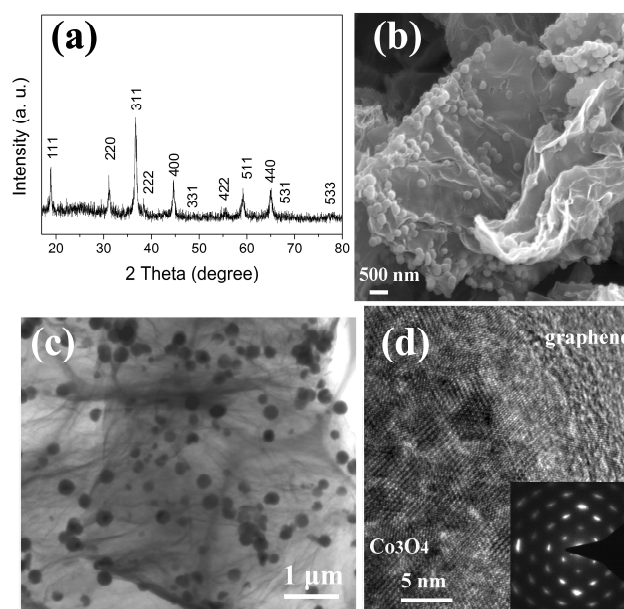


Figure S2 Structural characterization of the graphene/ Co_3O_4 composite. (a) XRD pattern, (b) SEM image, (c) TEM image, and (d) HRTEM image, the inset: SAED pattern.

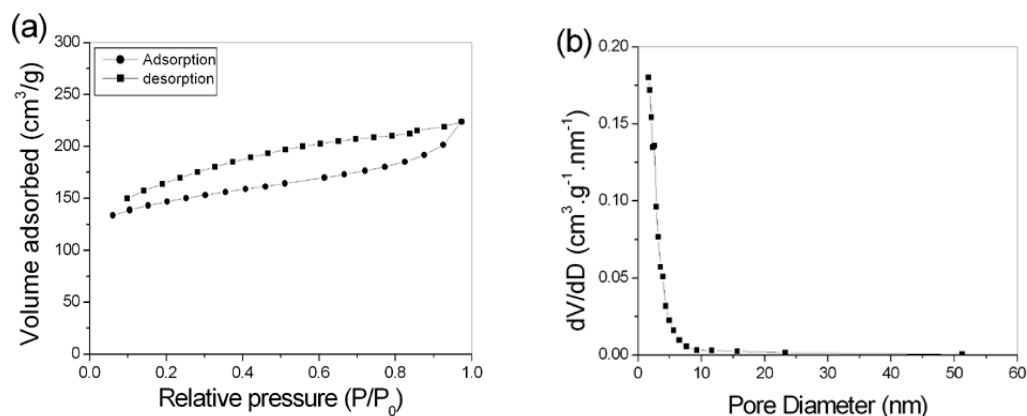


Figure S3 (a) Nitrogen adsorption and desorption isotherms of graphene powder and (b) the corresponding pore-size distribution calculated by BJH method from the desorption branch of graphene powder.

Figure S3 shows the nitrogen adsorption-desorption isotherm and the corresponding Barret-Joyner-Halenda (BJH) pore size distribution curve of the graphene powder. The measured Brunauer-Emmett-Teller (BET) area of the graphene powder is $516.7 \text{ m}^2 \text{ g}^{-1}$. The average pore diameters of graphene/cobalt is 1.67 nm, calculated from the desorption branch of the nitrogen isotherm with the BJH method. The corresponding BJH desorption cumulative pore volumes is $0.195 \text{ cm}^3 \text{ g}^{-1}$.



Figure S4 Photograph of the solution obtained without the graphene.

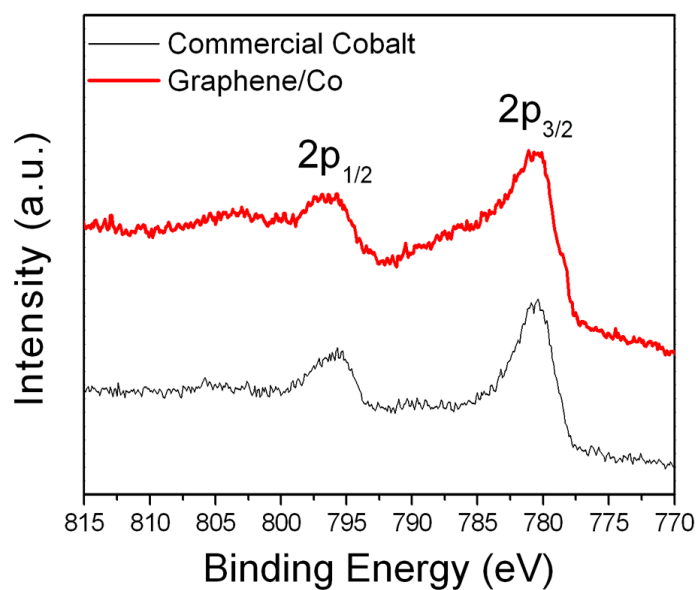


Figure S5 The Co 2p spectra of graphene/cobalt nanocomposite and commercial cobalt powder samples.

Although the XRD pattern (Fig. 1a) shows that Co_3O_4 in the composite was transformed into metallic cobalt after the thermal treatment at 623 K for 1 h under Ar/H_2 gas flow, however, the XPS spectrum (Fig. S5) exhibits that the surface cobalt is largely present as cobalt oxide with the Co $2p_{3/2}$ at about 780.5 eV.^{S1} It indicates

that the surface of the graphene/cobalt nanocomposite is easily oxidized due to the small particle size and high surface area, which is similar to that of commercial cobalt powder.

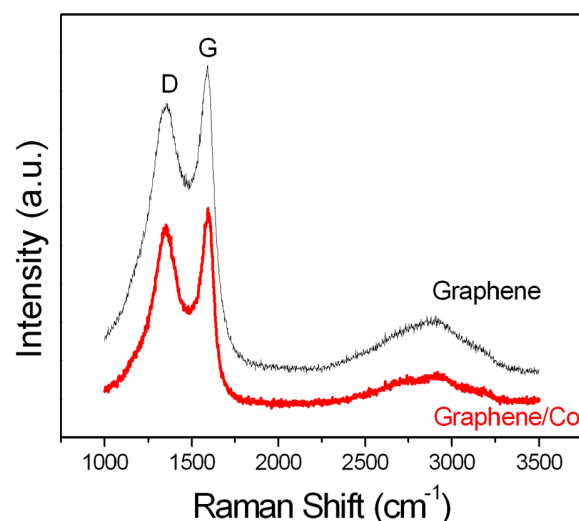


Figure S6 Raman spectra of the graphene/cobalt nanocomposite, graphene and commercial cobalt powder samples.

The Raman spectra of the graphene/cobalt nanocomposite show two broad bands at about 1349 and 1589 cm^{-1} , respectively. The band at 1589 cm^{-1} can be assigned to the E_{2g} mode of graphite, while the band centered at 1349 cm^{-1} is the disorder-induced peak characteristics of highly defective graphite.^{S2,S3}

References:

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