

Supporting information

Size-controlled Pd decorated on reduced graphene oxides as highly active catalysts for methanol oxidation and Suzuki-Miyaura reaction

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Synthesis of graphene oxide (GO):

Firstly, 4.0 g natural graphite was added into a reaction flask containing sulfuric acid (72 ml) and nitric acid (36 ml) in a magnetic stir bar. After the graphite powder was well dispersed, potassium chlorate (44 g) was slowly added for 1 hour to avoid rapid increase of temperature. The reaction flask was allowed to stir for 96 h at room temperature. In order to avoid environment pollution, sodium hydroxide was used to absorb the generated chlorine. Secondly, the mixture was slowly poured into deionized water and washed by 5% HCl solution twice in order to remove sulfate ions. After reduction of chloride ions, the color of the solution turned into brown-black from dark green. Thirdly, the brown black solutions were diluted and ultrasonicated for 30min to further exfoliate the graphene oxide sheets, and then centrifuged at 8000 r/min for 10min in order to remove the unexfoliated graphite. 20 ml of NaOH (5 mol·L⁻¹) was added into the GO solution (1000 ml) with stirring. After standing for 1

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h, GO was coagulated from the GO solution. Solid GO was filtered and washed with ethanol until neutral in order to remove excessive NaOH. The GO solids were obtained after dried under vacuum at 40 °C.

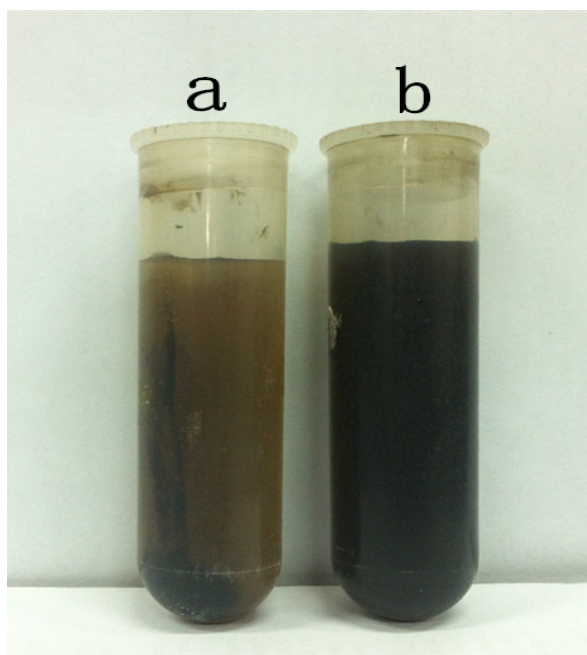


Fig. S1 Digital photos of GO and Pd (NO₃)₂ after react for one hour: (a) after centrifugation at 8000 r/min for 10 min and (b) before centrifugation. The color of the solution changed from black to yellow-brown and there are solid PdO/GO precipitations in the bottom of the centrifuge tube.

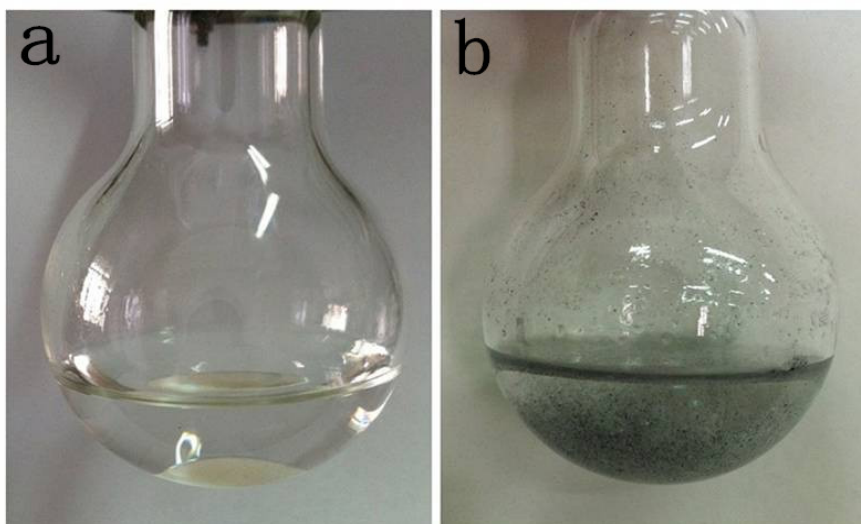


Fig. S2 Digital photos of Suzuki reaction: (a) Bromobenzene and phenylboronic acid reacted for 2 hour at 80°C without adding any catalyst and (b) Bromobenzene and phenylboronic acid reacted for 2 hour at 80°C with 2mg Pd/RGO. After cooling to the room temperature, there were many small crystal plates in Fig. S2b while there was nothing in Fig. S2a, indicating the reaction can react with the catalyst of Pd/RGO.

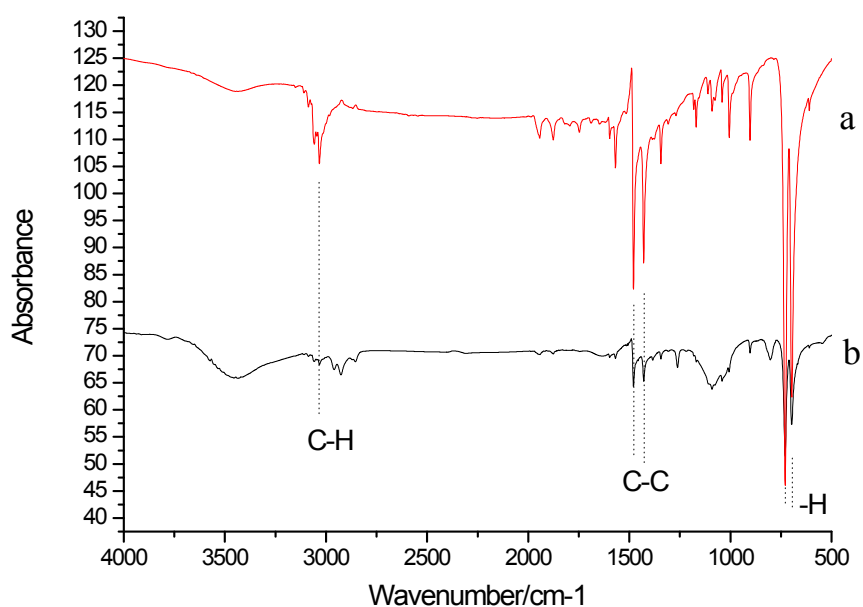


Fig. S3 FTIR of commercial biphenyl (a) and the reacted product of biphenyl (b). The peak at 3030 cm^{-1} was assigned to the -C-H- stretching vibrations. Two peaks at

1479.23 and 1428.88 cm^{-1} can be assigned to -C=C- vibrations. Two peaks at 729.24 and 696.74 cm^{-1} can be assigned to -H plane bending vibrations of biphenyl.

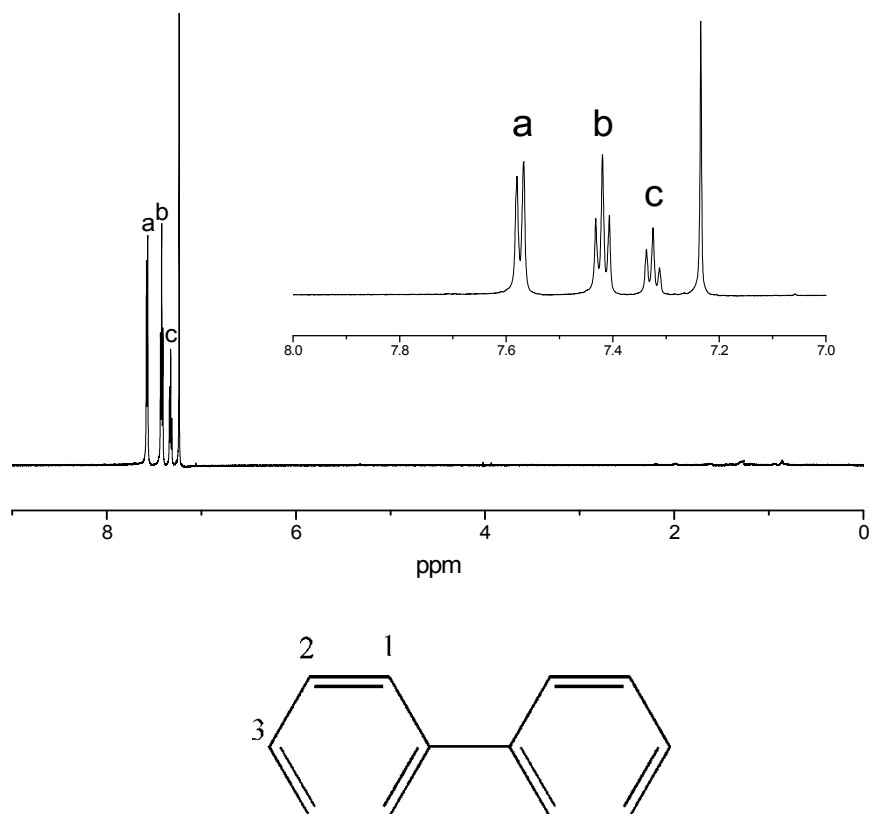


Fig. S4 ^1H NMR spectra of the resulted biphenyl. There were four peaks in the ^1H NMR spectrum as shown in the image. Among them, peaks a, b and c in the region $\delta 7.3\text{-}7.6$ ppm belonged to biphenyl. Peak at 7.35 ppm (c) attributed to 3 in the structure of biphenyl, at 7.44 ppm (b) belonged to 2, and at 7.59 ppm (a) belonged to 1 in the structure. Peak can be distinctly observed at $\delta 7.26$ ppm attributed to CDCl_3 solvent.

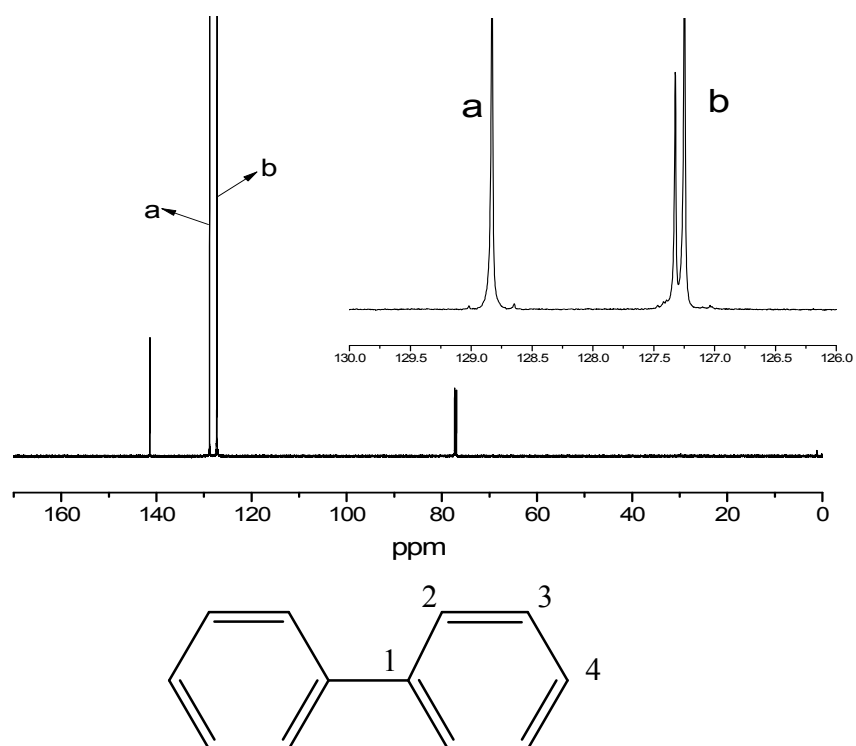


Fig. S5 ^{13}C NMR spectra of the resulted biphenyl. As shown in the image, peaks at 77.0 ppm belonged to CDCl_3 solvent. There were four peaks in the region $\delta 127.0$ -142.0 ppm, which belonged to biphenyl. Peak at 128.82 ppm (a) attributed to 3 in the structure of the biphenyl, and peaks at 127.30 and 127.43 ppm (b) belonged to 4 and 2 in the structure. Peak at 141.6 ppm attributed to 1 in the image.