

SUPPORTING INFORMATION

Materials

Graphite powder (SP-1 graphite) was obtained from Bay carbon. Nylon-6 pellets, hydriodic acid (HI), acetic acid, and formic acid have been purchased from Sigma-Aldrich (Germany)

Preparation of GO solution

Graphene oxide (GO) was prepared from natural graphite powder using the modified Hummers and Offenman's method with H_2SO_4 , NaNO_3 and KMnO_4 .^{1, 2} As-synthesized GO was dispersed in distilled water by ultrasonication (Sonoplus HD 2200, Bandelin Co.) for 30 min. Unexfoliated GO was removed by a 30 min centrifugation at 10,000 rpm. The dispersed GO solution have been found to be stable at room temperature for several months without precipitation. The different concentrations of GO solution were prepared including 0.02, 0.05, 0.1, 0.5, 1 mg/ml.

Preparation of nylon-6 fibers on interdigitated electrodes (IDEs)

Nylon-6 pellets were dissolved in formic acid solution at a concentration of 25 wt%. The mixture was stirred for 4 h at 60 °C in sealed bottles to form the wet paste for electrospinning. Then, the nylon-6 solution was loaded in a 10 ml syringe attached to a syringe pump. (KDS200, KD Scientific Inc.) The feeding rate of the solution was 0.1 ml/h, which was controlled by a syringe pump. The range of applied voltage between needle and metal collector was 15 to 25 KV. The average diameter of fibers decreases from 250 nm to 150 nm with increasing applied voltage. (**Fig. S1**) The eletro-spun nylon-6 nanofibers were collected on SiO_2/Si substrate with IDEs (finger spacing = 10 μm), which were placed 10 cm away from the syringe needle. After collecting, the pure nylon-6 nanofibers onto the IDEs were dried in hood at room temperature for 2h before use.

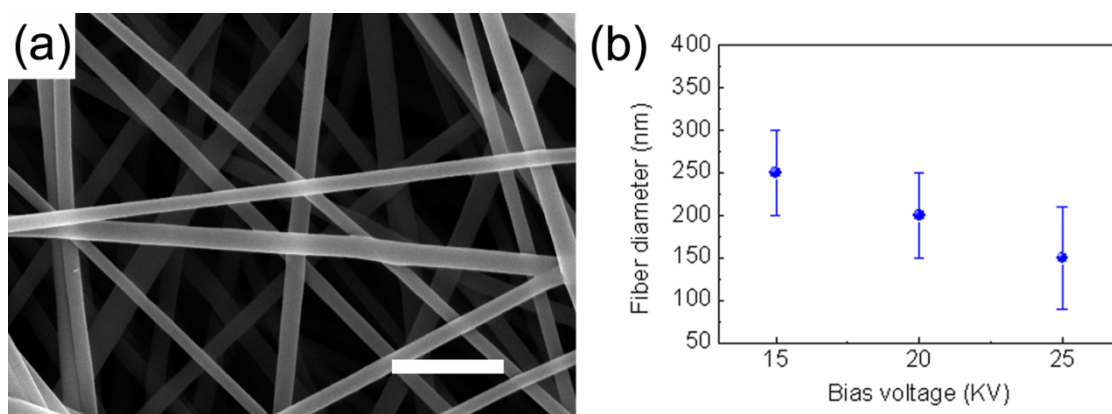


Fig. S1. (a) SEM image of nylon-6 nanofiber synthesized at 25 KV bias voltage. Scale bar: 1 μm . (b) Plot of fiber diameter distribution of electro-spun nylon-6 nanofibers with different bias voltages.

Preparation of FRGO gas sensor

BSA (bovine serum albumin)-coated devices for GO wrapping were prepared by dropping about 2 μL of 1 wt% BSA solution on the as-obtained devices containing electro-spun nylon-6 nanofibers. Upon completion of the coating, the resulting devices were dried in hood for 1h, and washed with distilled water to remove excess BSA molecules. To form a GO network, GO suspension (0.1 mg/ml, pH 4) was dropped onto a BSA-functionalized nylon-6 nanofiber mat placed on the IDEs (interdigitated electrodes). After GO coating, the devices were rinsed briefly in deionized water, and dried under 60 $^{\circ}\text{C}$ for 6 h. The RGO sensors were obtained from GO device using hydriodic acid (HI) vapor reduction method.¹ The GO wrapped nylon-6 devices were placed inside a 300 mL glass vessel containing 2.0 mL of HI and 5.0 mL of acetic acid. The cover of the vessel was sealed with vacuum grease and placed over on oil bath at 40 $^{\circ}\text{C}$ for 10 min. Subsequently, the RGO devices were rinsed with a saturated sodium bicarbonate solution, water and methanol, and dried at room temperature. The color of the GO devices changed from white or ivory to brown after treatment with HI vapor, indicating the reduction of GO, as depicted in **Fig. 1(b)(iii)**.

Characterizations

The morphology and microstructure of the resulting devices were obtained using field emission scanning electron microscopy (FESEM, FEI Sirion 200) and high-resolution images were obtained by using high-

resolution transmission electron microscopy (HRTEM, FEI 300). The thickness and lateral size of the dispersed GO nanosheets on mica substrate was obtained using atomic force microscopy (AFM, Veeco, DI3100) with a sharp silicon probe (the radius of curvature of the tip was < 5 nm). Raman spectra were measured using Raman spectroscopy (LabRAM Aramis, Horiba Scientific).

AFM image of GO nanosheet

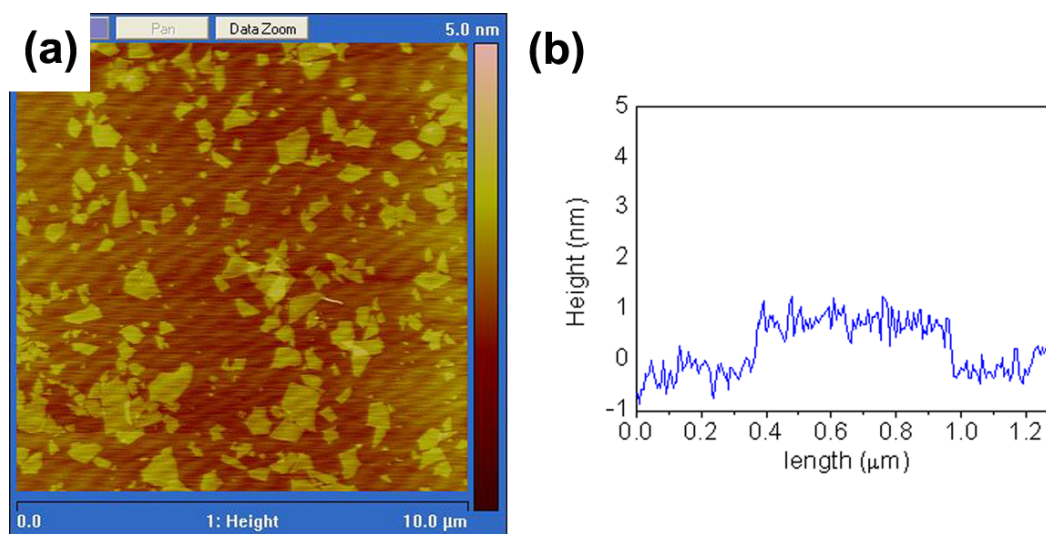


Fig. S2. AFM image and cross-section profile of GO nanosheet.

High resolution transmission electron microscopy image of a FRGO

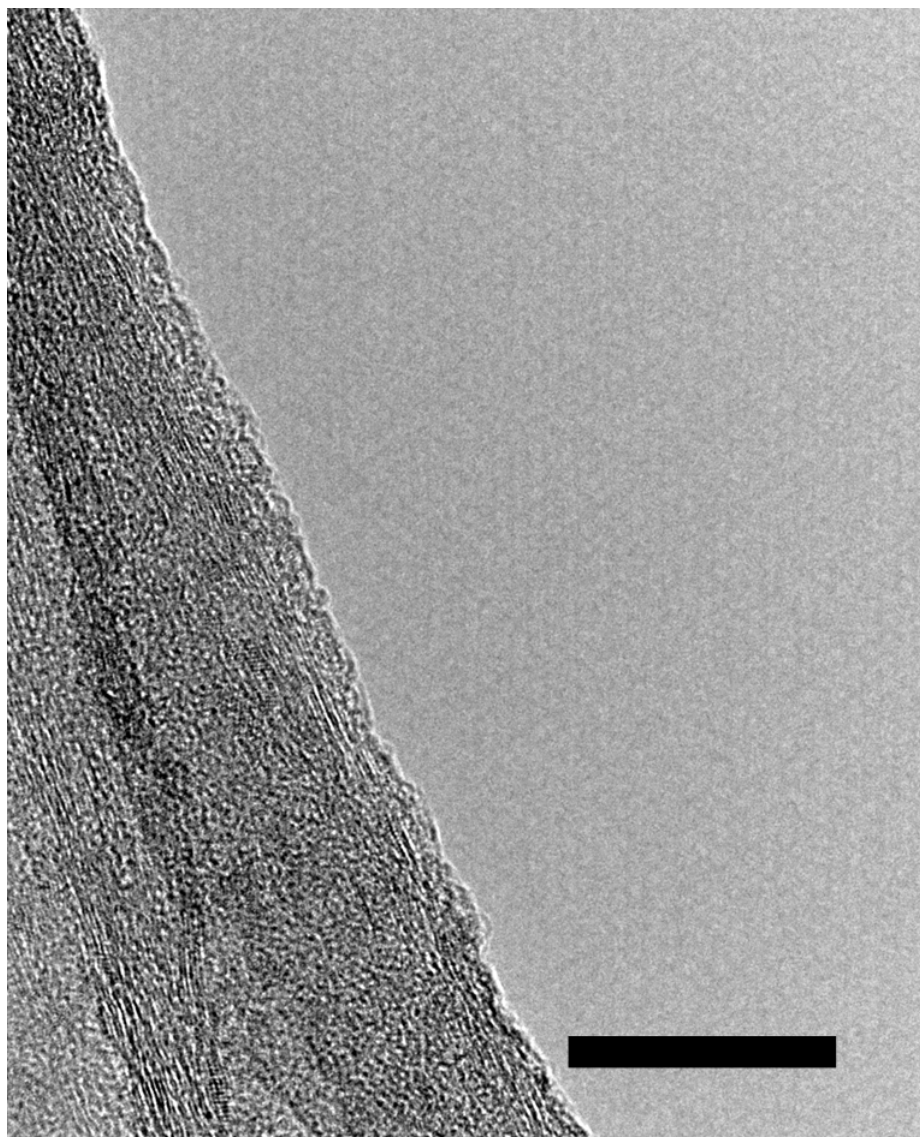


Fig. S3. HRTEM image of a FRGO nanofiber. Scale bar: 10 nm.

Measurements of gas sensing characteristics

The sensor devices prepared on Si substrates were located in a gas measurement chamber equipped with a hot-chuck as an external heater and a water-cooling unit. Air as a balance gas was used at a 1000 cc/min flow rate while NO₂ gas of 50 parts per million (ppm) was used as an analyte. The analyte was mixed with air to achieve a desired concentration of 0.25 ppm to 4.5 ppm by using mass flow controllers (MFCs), as shown in Fig S4. The sensors were heated by the hot-chuck at 100°C. The response of the sensor devices to the analyte was recorded by monitoring the resistance changes of the sensing materials.

The response of the sensor device was defined as below:

$$S (\text{response, \%}) = (R_a - R_g) / R_a * 100$$

where R_a is the resistance of the sensing material in the air and R_g is a resistance of the sensing material in the analyte.

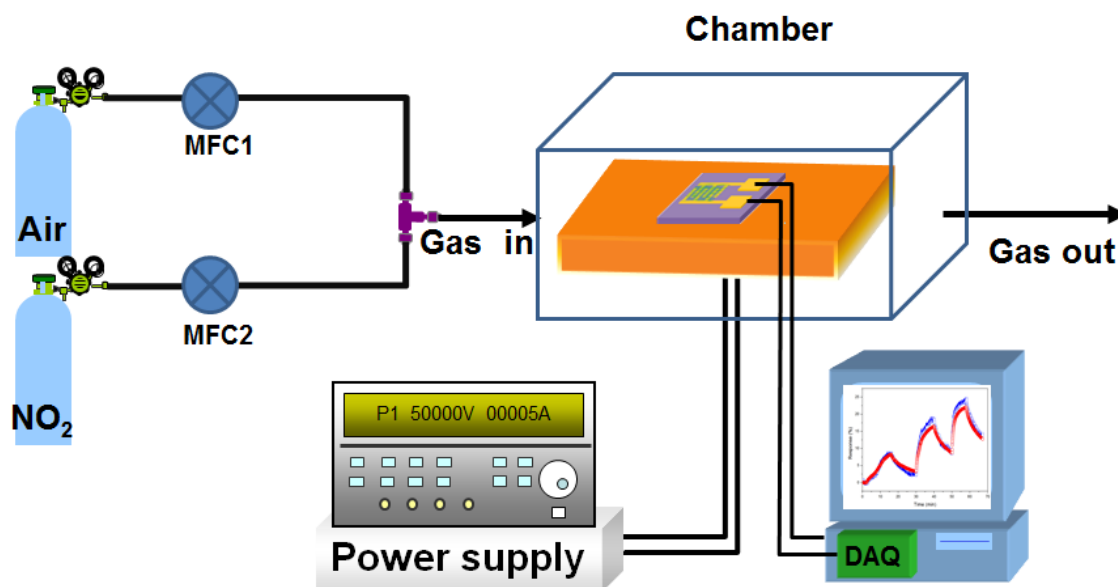


Fig. S4. Measurement set-up for sensing characteristics of gas sensor devices

Raman spectrum of FRGO

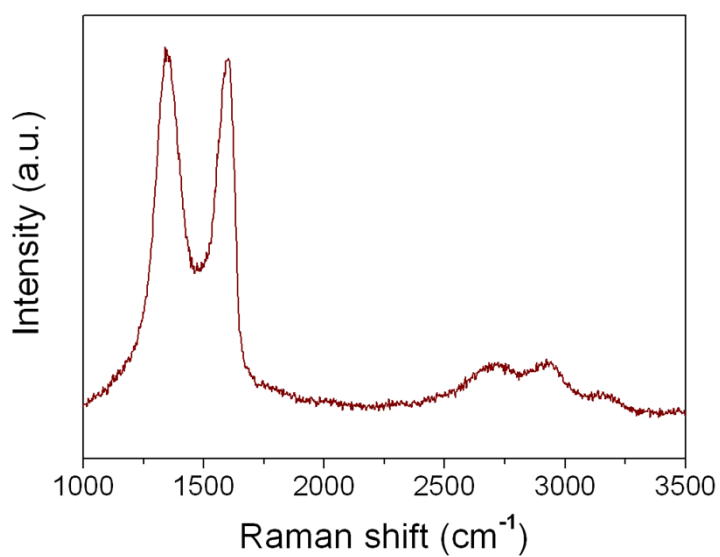


Fig. S5. Raman spectrum of FRGO gas sensor after thermal treatment at 300°C.

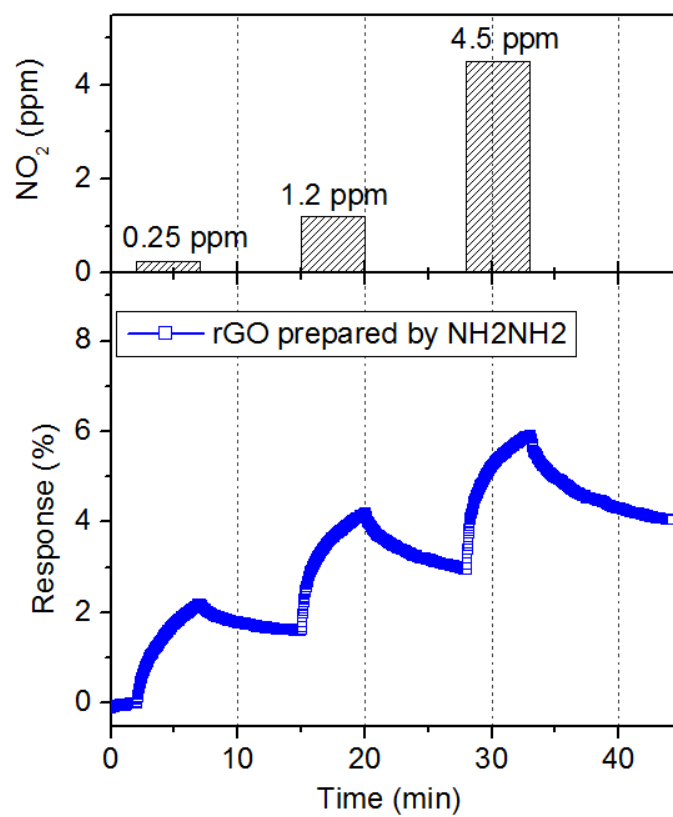


Fig. S6. NO₂ gas sensing behavior of simple reduced graphene oxide without e-spun nanofiber templates

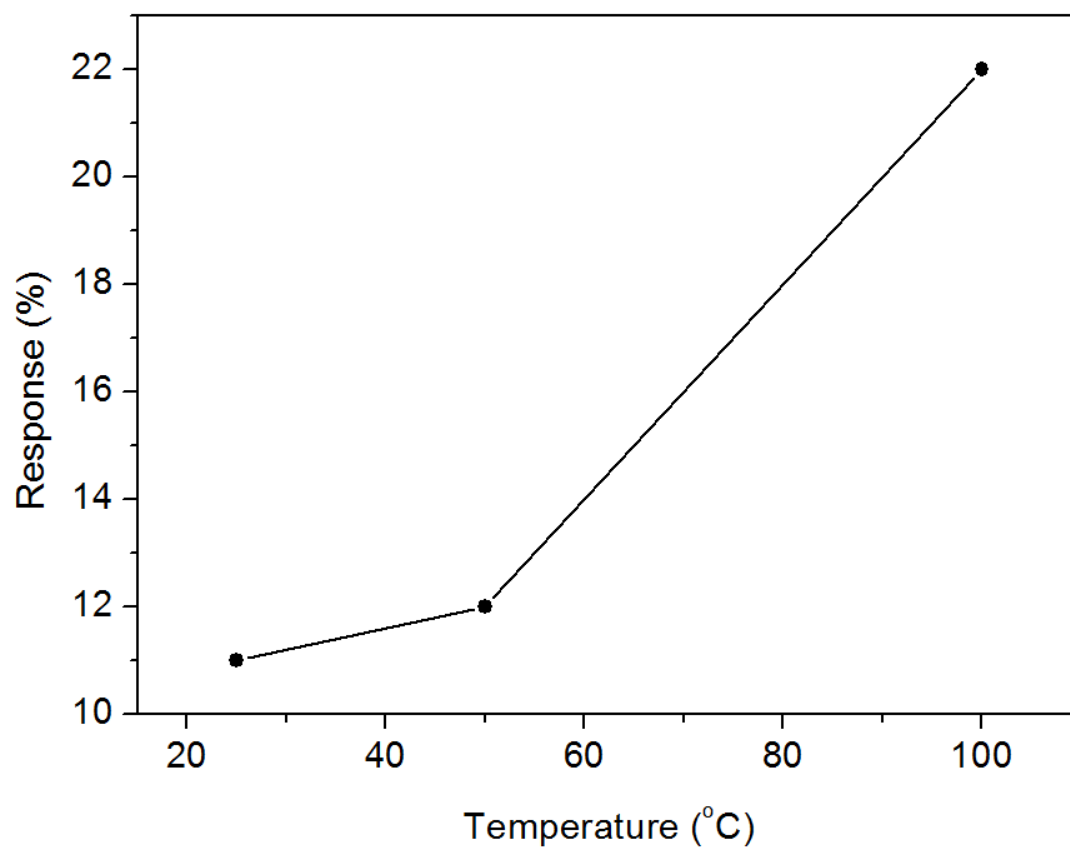


Fig. S7. Comparison of gas response to NO₂ 4.5 ppm depending on temperatures

Reference

[1] Hummers et al. J. Am. Chem. Soc., 1958, **80**, 1339.

[2] Cote, L. J.; Kim, F.; Huang, J. Am. Chem. Soc., 2008, **131**, 1043-1049.