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Graphene quantum dots functionalized three-dimensional ordered mesoporous ZnO for acetone detection toward diagnosis of diabetes

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Experimental Section

Characterization.

The surface morphology of the as-prepared 3DOM samples was inspected using a JEOL JSM—7500F SEM at an accelerating voltage of 15 kV with gold sputtered on the samples. TEM and HR-TEM images were recorded on a JEM—2010 transmission electron microscope under a working voltage of 200 kV. The phase structures were characterized by XRD which were conducted on Rigaku D/max 2550 X-ray diffractomete using a mono-chromatized Cu target radiation source (λ=1.5045Å). The corresponding lattice constants were calculated by MDI Jade 5.0 software. The chemical components and bonding states of the samples were investigated by XPS using an ESCAlab250 Analytical XPL spectrometer with a monochromatic Al K-α source. The fitted peaks in XPS spectra were deconvoluted using the XPS Peak 4.1 software. The BET surface area was confirmed by the N_2 adsorption−desorption isotherms (Asap2420, Micromeritics) at 77 K. FTIR were recorded on a Vertex 80 V (Brucker) FTIR spectrometer in the range of 400–4000 cm^{-1}. The thermal behaviour of the samples was evaluated by TGA, (Q500, TA). The EIS plot (Impedance-Potential characteristics) was measured on a CHI660D electrochemical workstation (ChenHua Instruments Co., Ltd., Shanghai, China). The electrochemical studies were carried out using a simple three-electrode system with the drop casted films acting as the working electrode, while Ag/AgCl and Pt wires were used as the reference and counter electrodes, respectively. For EIS curves were measured in PBS solution (pH 7.4) containing 5 mM $K_3[Fe(CN)_6]$. The gas sensing properties were measured using a WS-30 gas sensing system, which was purchased from Weisheng Instruments Company (Zhengzhou, China).

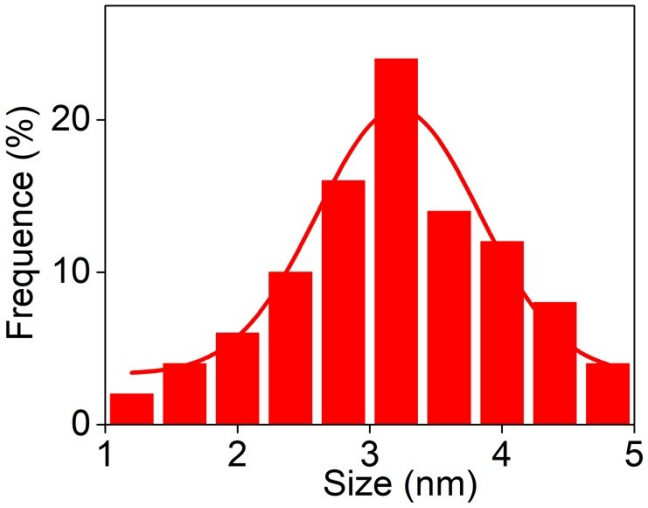

Fig. S1 The diameter distribution of GQDs.

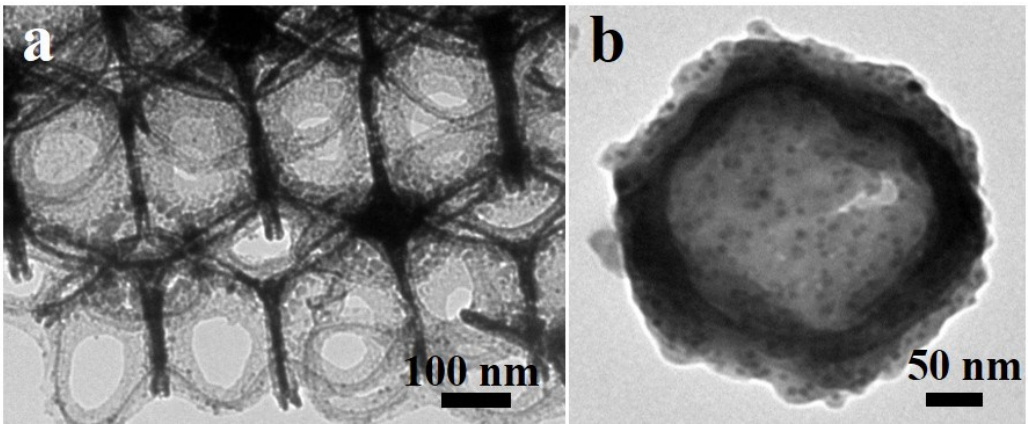

Fig. S2 (a) TEM image of pure 3DOM ZnO sample. (b) TEM image of a single hexagonal porous structure from the GQDs modified 3DOM ZnO sample.

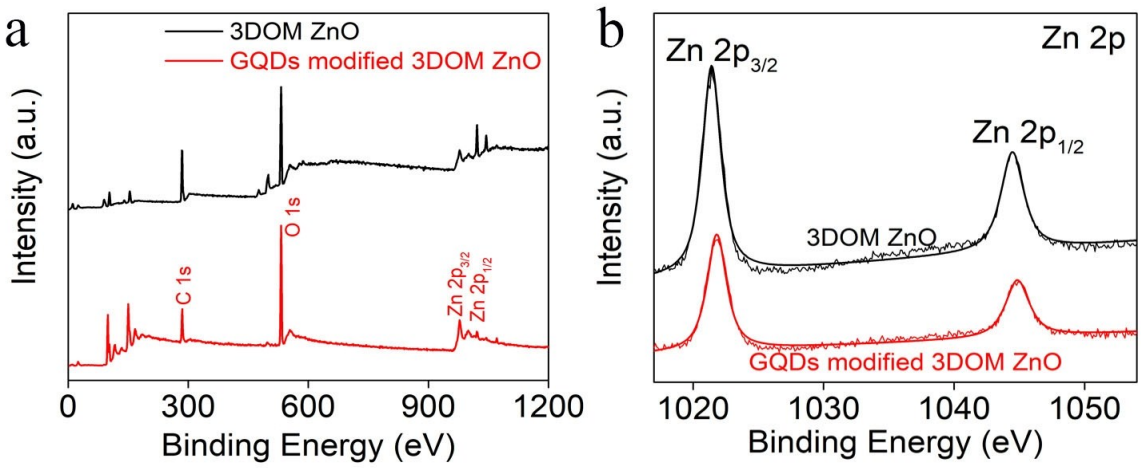

Fig. S3 (a) The complete XPS spectra and (b) Zn 2p of GQDs modified 3DOM ZnO and 3DOM ZnO samples.

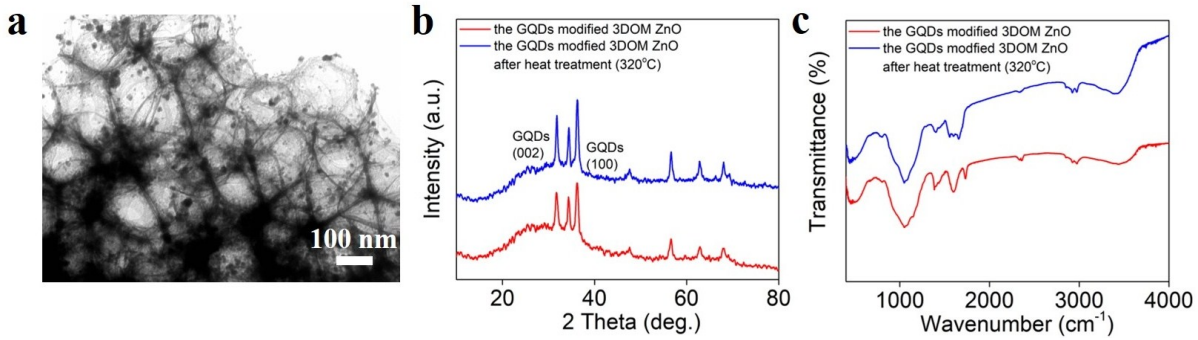

Fig. S4 (a) TEM image of the GQDs modified 3DOM ZnO sample after 320°C heat treatment for 3 h. (b) XRD pattern and (c) FTIR spectra of the GQDs modified 3DOM ZnO sample before and after 320°C heat treatment.

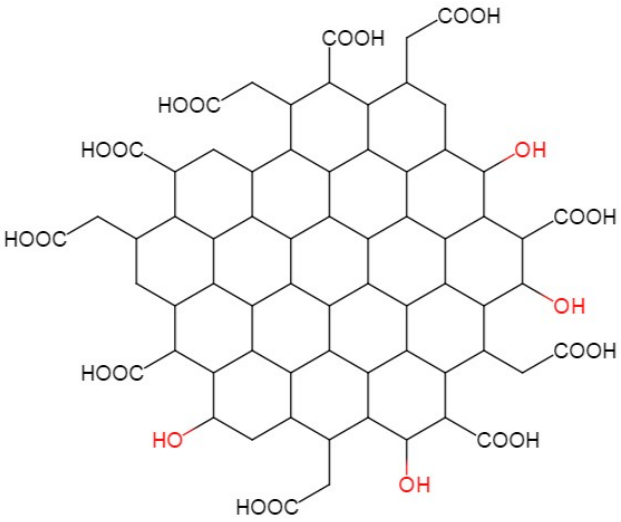

Fig. S5 Chemical structural formula of GQDs.

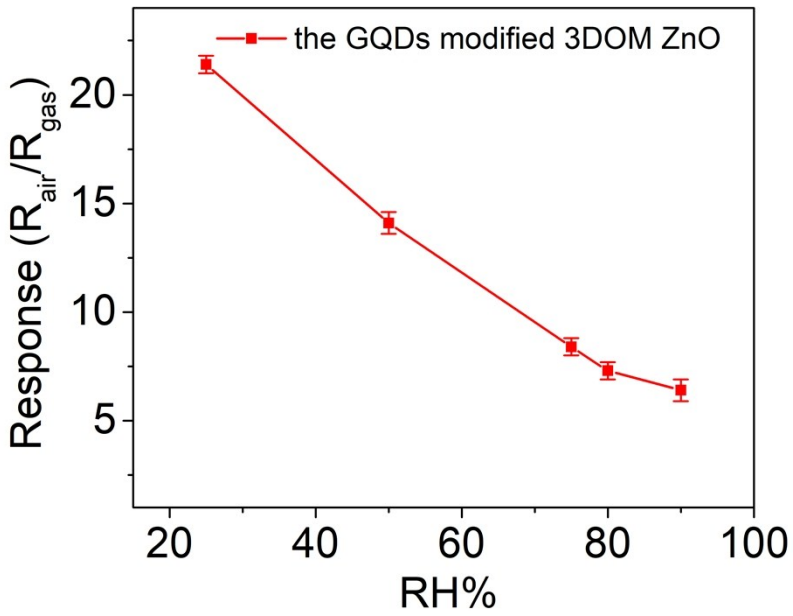

Fig. S6 The response of the GQDs modified 3DOM ZnO sensor (2 ppm acetone) as function of RH%.