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Hierarchical SnO_2 Architectures: Controllable Growth on Graphene by Atmospheric Pressure Chemical Vapour Deposition and Application in Cataluminescence Gas Sensor

Lingzhu Yu,[a] Lichun Zhang,[a] Hongjie Song,[a] Xiaoming Jiang,[b] Xiandeng Hou,[b] and Yi Lv*,[a]

[a]Key Laboratory of Green Chemistry & Technology, Ministry of Education, College of Chemistry, Sichuan University, Chengdu, Sichuan 610064, China.

[b]Analytical & Testing Center, Sichuan University, Chengdu, Sichuan 610064, China.

Corresponding Author: Professor Yi Lv, Key Laboratory of Green Chemistry & Technology, Ministry of Education, College of Chemistry, Sichuan University, Chengdu, Sichuan 610064, China. Tel. & Fax +86-28-8541-2798. E-mail: lvy@scu.edu.cn

Supporting Information

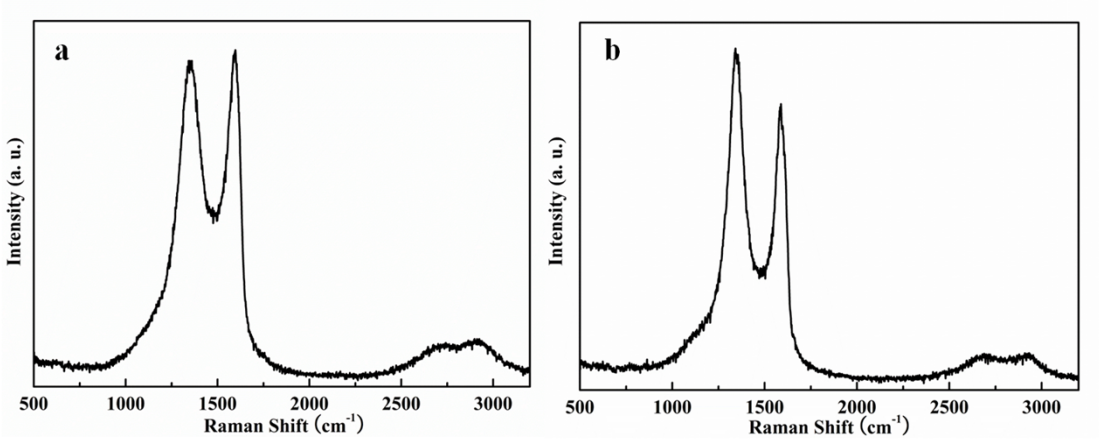

Fig. S1 Raman spectra of (a) TRGO substrate and (b) CRGO substrate.

As shown in Fig. S1a, the Raman spectrum of TRGO was characterized by two prominent bands at 1360 and 1597 cm^{-1}, which corresponded to the D and G modes. The G band arose from the first-order scattering of the E_{2g} mode,[1, 2] corresponding to ordered sp^2-bonded carbon atoms. However, the D band was ascribed to edges, other defects, and disordered carbon atoms.[3, 4]

As shown in Fig. S1b, the Raman spectrum of CRGO contained both D and G bands (at 1342 and 1588 cm^{-1}, respectively). The D band at 1342 cm^{-1} became prominent with an increased D/G intensity ratio of 1.18 for CRGO. This change suggested a decrease in the average size of the sp^2 domains upon reduction of the exfoliated GO.[1]

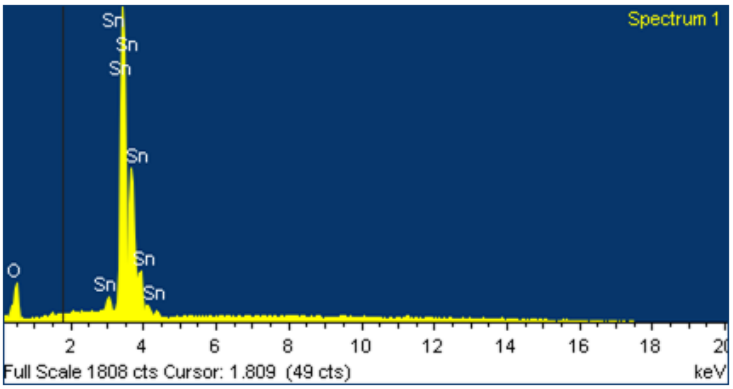

Fig. S2 EDX spectrum of SnO_2/TRGO materials deposited at 580 °C for 60 min.

Table S1 Binding energy and percentage of functional groups in C1s XPS spectra of TRGO

TRGO[a]					TRGO[b]				
Functional groups	C=C	C-O	C=O	O=C-OH	Functional groups	C=C	C-O	C=O	O=C-OH
Binding energy (eV)	284.6	285.7	287.3	289.2	Binding energy (eV)	284.6	285.8	287.5	289.5
Relative percentage	52.99%	27.95%	10.62%	8.45%	Relative percentage	60.53%	27.48%	6.03%	5.96%

[a] The bare TRGO

[b] TRGO after deposition SnO_2 materials.

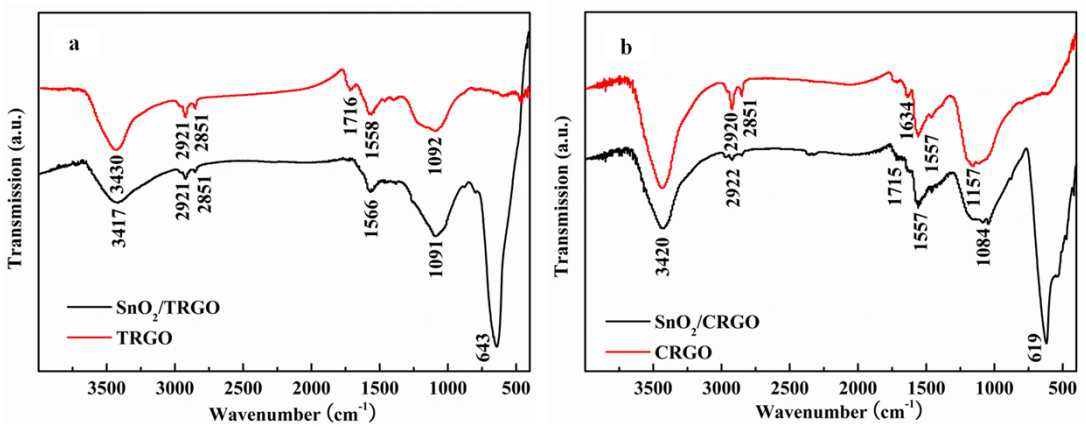

Fig. S3 FT-IR spectra of (a) bare TRGO and SnO_2/TRGO materials deposited at 580 °C for 60 min and (b) bare CRGO and SnO_2/CRGO materials deposited at 580 °C for 60 min.

The FT-IR spectrum of TRGO (Fig. S3a) showed the presence of residual oxygenated functional groups. The 1092 cm^{-1} assigned to C-O stretching vibrations, 1558 cm^{-1} assigned to C=C stretching vibrations, which was red shifts because of the calcination treatment. The 1716 cm^{-1} assigned to carbonyl or carboxyl stretching vibrations, 3430 cm^{-1} assigned to -OH stretching vibrations. After deposition SnO_2, the peak of 1716 cm^{-1} disappeared, revealing the TRGO was further reduced. The new peak of 643 cm^{-1} corresponded to SnO_2.

Fig. S3b showed the FT-IR spectrum of CRGO. The 1157 cm^{-1} assigned to C-O stretching vibrations, 1557 cm^{-1} and 1634 cm^{-1} assigned to C=C stretching vibrations, the 1557 cm^{-1} was red shifts because of the calcination treatment. The 1715 cm^{-1} assigned to carbonyl or carboxyl stretching vibrations, 3420 cm^{-1} assigned to -OH stretching vibrations. After deposition SnO_2, the corresponding peaks had no significant change. The new peak of 619 cm^{-1} corresponded to SnO_2.

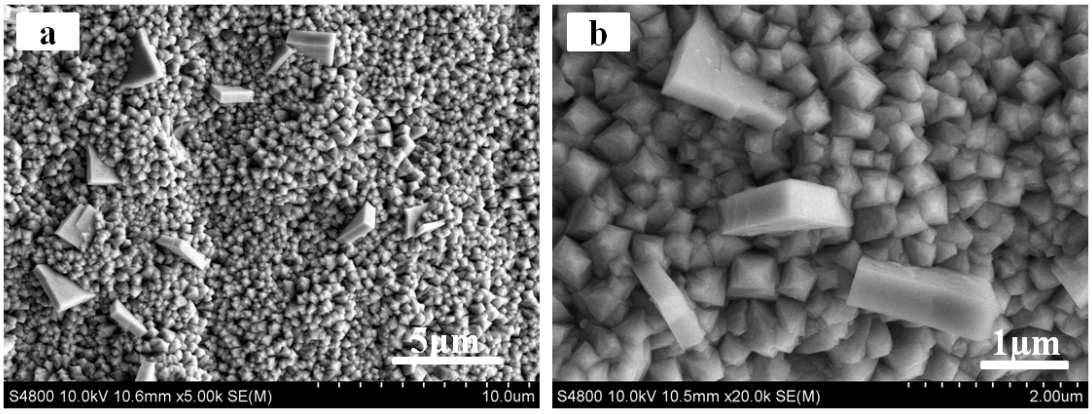

Fig. S4 (a) FE-SEM image of SnO_2/TRGO nanobrick@nanorod hybrid structure and (b) the corresponding high-magnification SEM image.

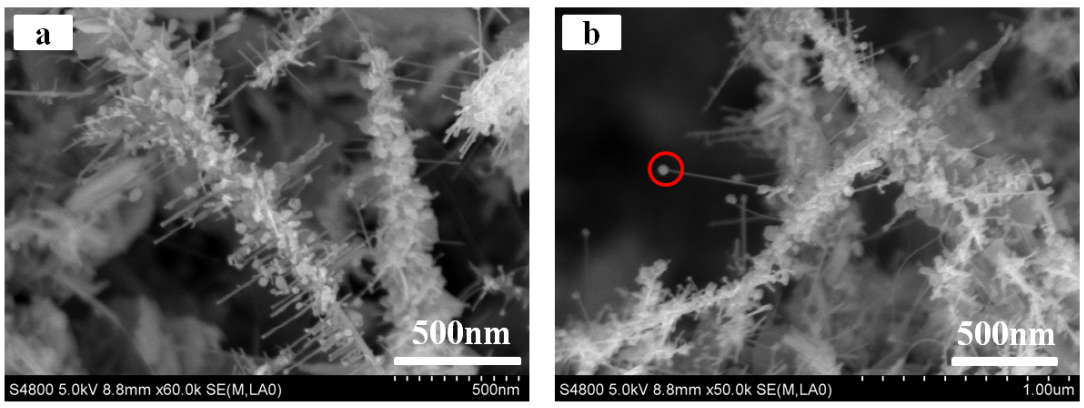

Fig. S5 (a and b) High-magnification FE-SEM images of SnO_2 dendrite structure deposited at 620 ^oC for 60 min, which consisted of nanorods and nanowires with spherical particles located on the top.

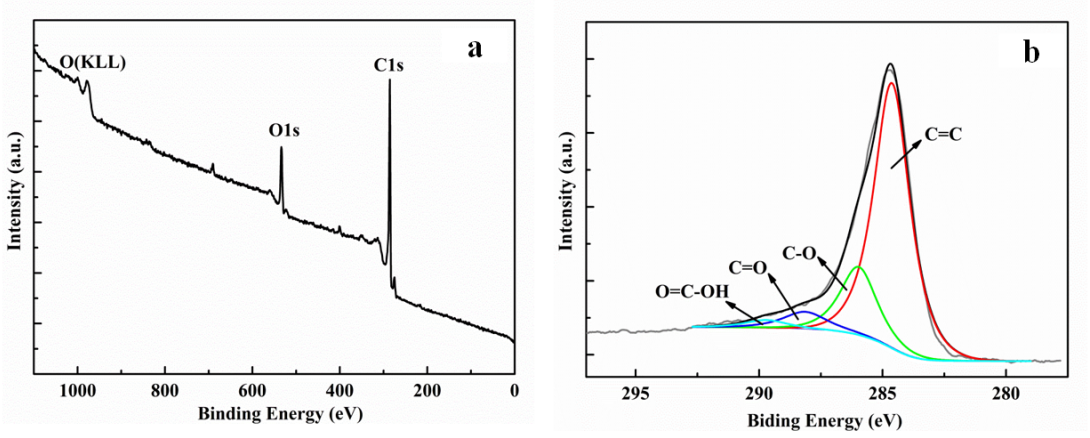

Fig. S6 (a) XPS spectrum of CRGO. (b) C 1s peaks of CRGO.

Table S2 Binding energy and percentage of functional groups in C1s XPS spectra of CRGO

Functional groups	C=C	C-O	C=O	O=C-OH
Binding energy (eV)	284.6	286.0	288.1	289.7
Relative percentage	72.63%	19.09%	5.77%	2.51%

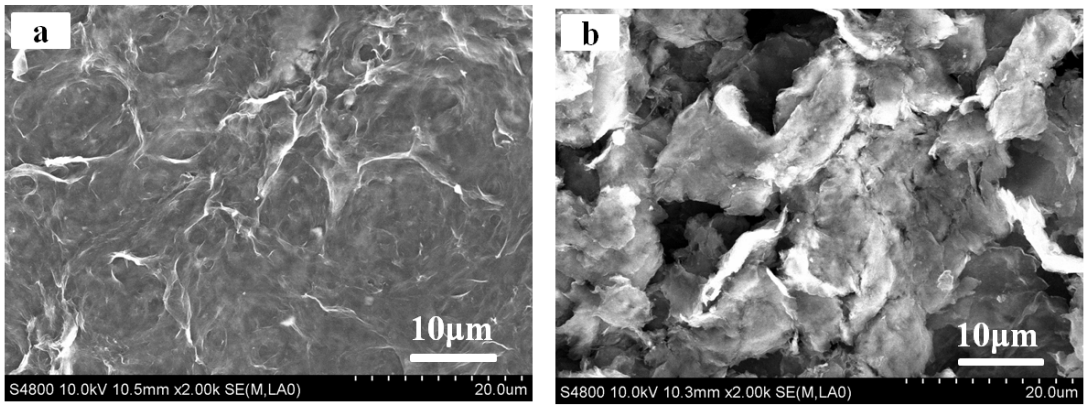

Fig. S7 (a) FE-SEM image of bare TRGO. (b) FE-SEM image of bare CRGO.

References

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4. H. J. Song, L. Y. Hao, Y. F. Tian, X. Y. Wan, L. C. Zhang, Y. Lv, *ChemPlusChem*, 2012, **77**, 379.