Supporting Information

A single $CuO/Cu_2O/Cu$ micro-wire covered by a nano-wire network as gas sensor for the detection of battery hazards

Oleg Lupan,[1,2,3,†] Nicolai Ababii,[2] Abhishek Kumar Mishra,[4,†] Ole Gronenberg,[5] Alexander Vahl,[6] Ulrich Schürmann,[5] Viola Duppel,[7] Helge Krüger,[1] Lee Chow,[3,†] Lorenz Kienle,[5,†] Franz Faupel,[6,†] Rainer Adelung[1,†] Nora H. de Leeuw,[8,†] Sandra Hansen,[1,†]

[1] *Functional Nanomaterials, Faculty of Engineering, Institute for Materials Science, Kiel University, Kaiser Str. 2, D-24143, Kiel, Germany*
[2] *Department of Micro-electronics and Bio-medical Engineering, Center for Nanotechnology and Nanosensors, Technical University of Moldova, Stefan cel Mare 168, MD2004, Moldova*
[3] *Physics Department, University of Central Florida, Orlando, FL, 32816, U.S.A.*
[4] *Physics Department, School of Engineering, University of Petroleum & Energy Studies, Bidholi via Premnagar, Dehradun, 248007, India*
[5] *Synthesis and Real Structure, Institute for Materials Science, Christian-Albrechts Universität zu Kiel, Kaiser str. 2, D-24143, Kiel, Germany*
[6] *Chair for Multicomponent Materials, Faculty of Engineering, Institute for Materials Science, Kiel University, Kaiser str. 2, D-24143, Kiel, Germany*
[7] *Max Planck Institute for Solid State Research, Heisenbergstraße 1, 70569 Stuttgart, Germany*
[8] *School of Chemistry, University of Leeds, Leeds LS2 9JT, United Kingdom*
[9] *School of Chemistry, Cardiff University, Main Building, Park Place, Cardiff CF10 3AT, United Kingdom*

[†] Corresponding authors:
Prof. Dr. O. Lupan, (ollu@tf.uni-kiel.de ; oleg.lupan@mib.utm.md)
Kiel University, Germany; Technical University of Moldova, Moldova; UCF, U.S.A.

Prof. Dr. A. K. Mishra, (akmishra@ddn.upes.ac.in)
University of Petroleum & Energy Studies, India

Prof. Dr. L. Chow, (lee.chow@ucf.edu)
University of Central Florida, U.S.A.

Prof. Dr. L. Kienle, (lk@tf.uni-kiel.de)
Christian-Albrechts Universität zu Kiel, Germany

Prof. Dr. R. Adelung, (ra@tf.uni-kiel.de)
Kiel University, Germany

Prof. Dr. N. H. de Leeuw, (n.h.deleeuw@leeds.ac.uk)

University of Leeds, United Kingdom

Dr. S. Hansen, (sn@tf.uni-kiel.de)
Kiel University, Germany

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For the gas detection studies the fabricated CuO/Cu_2O nanostructures are inserted and connected electrically in a special chamber at the desired working temperature for 40 min before applying the designated gases or VOC vapors to maintain the electrical baseline, the more details are described in our previously works.[1,2] During the measurements, the gas or VOC vapors flow was set at 500 sccm (ml/min) using pre-calibrated mass flow controllers and setting the selected gas or VOC vapors concentration to 100 ppm the **Equation 1** Supporting Information was used and for the calculation of the VOC vapors concentration the **Equation 2** Supporting Information was used. Precision sourcemeter (Keithley 2400) connected to a PC with suitable LabView (National Instruments) interface was used to monitor and record the parameters of the sensor structures in real time with the applied DC voltage of 0.5 V. The gas response was calculated from formula ($S_p = \frac{R_{gas}-R_{air}}{R_{air}} * 100$), where R_{gas} – electrical resistance of the sensor device under gas or under the vapors exposure and R_{air} - in ambient air, respectively and electrical conductivity showed *p*-type conductivity behavior.[1,3–6]

Thus, setting the selected gas or VOC vapors concentration to 100 ppm, was used to set the flow of gas mixed with air in the relation:[7]

$$C\ (ppm) = \frac{C_1 \cdot F_{gas}}{F_{tot}} \quad (1)$$

with C – the required concentration of gas; C_1 – the initial concentration of the test gas; F_{gas} – the gas flow; F_{tot} – the total flow of the gas-air mixture.

For the calculation of the VOC vapors concentration the following relation was used:[8]

$$V_x = (Vol \cdot C \cdot M)/(22.4 \cdot d \cdot p) \cdot [(273 + T_r)/(273 + T_c)] \cdot 10^{-9} \quad (2)$$