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Microwave hydrothermal synthesis of nickel sulphide- reduced graphene oxide composites

The harmful and life-threatening properties of methane (CH4) and carbon monoxide (CO) gases at low temperatures has led to extensive research for suitable detection. Semiconducting metal oxides (SMOs) have been thoroughly studied in sensing due to their favourable characteristics, for instance, their low cost, long lifetime, fast response time and high sensitivity [1]. Nonetheless, the practical application of these materials is limiting because they operate at high temperatures, have poor recovery and limited selectivity [2]. Researchers are currently looking for materials with improved high selectivity, high sensitivity and low power consumption.

Metal sulphide composites have recently attracted much attention due to their excellent properties and their promising application in Li-ion batteries, supercapacitors, solar cells and oxygen reduction reactions (ORR) to name a few [3]. The Ni3S2 catalyst is the most stable polymorph of the nickel sulphide family. It is reported to having a room temperature resistivity of 1.8 Ω.cm, is a good conductor, and has been used for humidity sensing [4]. Reduced graphene oxide (rGO) on the other hand has a large surface-to-volume ratio and good conductivity, which can be easily tuned by increasing or decreasing the defect sites [5]. rGO has helped improve the sensitivity, selectivity and lowered the operating temperatures of SMOs.

In this work, a green, simple and affordable microwave hydrothermal technique was employed for the synthesis of nickel sulphide -reduced graphene oxide composites. Sequential addition of metal precursors, wt % of the catalyst and time study were conducted. The morphological, structural and chemical properties were sufficiently characterized using transmission electron microscopy (TEM), scanning electron microscopy (SEM), energy dispersive spectroscopy (EDS), x-ray diffraction analysis (XRD), Raman spectroscopy, Fourier transform infrared (FTIR) spectroscopy, Ultra Violet-Visible spectroscopy (UV-vis), photoluminescence (PL), Brunauer-Emmet-Teller (BET) surface area analysis and thermogravimetric analysis (TGA). From SEM analysis, we noticed quasi-spherical nanosized particles on the rGO sheets with a crumpled structure. During the time study, we observed a difference in the particles on the rGO sheets. At 4 minutes, the nickel sulphide appears as layered, irregular flaky particles. As time increases the layered structures form quasi-spherical nanosized seed like structures with a rough surface. At 10 minutes, the seed like structures has a smoother and more ordered quasi-spherical morphology.

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[1] Sh. Nasresfahani, M.H. Sheikhi, M. Tohidi, A. Zarifkar, Materials Research Bulletin 89, 161–169, (2017).
[2] G. Neri, Chemosensors 3, 1-20 (2015).
[3] C. Lai, M. Lu, L. Chen, Journal of Materials Chemistry, 22, 19-30, (2012).
[4] E. C. Linganiso, Microwave Assisted Techniques for Synthesis of NiSx and GaN Semiconductor Nanostructures for Application in Sensors, PhD Thesis (2014), University of the Witwatersrand Johannesburg.
[5] H. Ren, C. Gu, S. W. Joo, J. Cui, Y. Sun, and J. Huan, Materials Express, 8,3, (2018).

Apply to be
 considered for a student
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Yes

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MSc

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