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RGO decorated ZnO nanosheets for Temperature Sensor Applications

Abstract:

2D nano materials have become most popular at present day technology in research and development due to their exceptional electrical, thermal, chemical & mechanical properties and higher surface to volume ratio [1]. Therefore, the above properties of 2D materials are expecting to have better device/sensor properties. Recently, temperature sensors are playing significant attention in environmental and biomedical applications for precise measurements. However, the conventional temperature sensors are exhibiting lower sensitivity and temperature coefficient resistance (TCR) values. Therefore, enhancement of temperature sensor properties and their development are in demand at present [2]. Hence, we present here with development of temperature sensor with improved characteristics of sensitivity and TCR by using RGO decorated ZnO nanosheets. The 2D ZnO nanosheets are synthesized using hydrothermal method, similar to our previous report [3], whereas the RGO nanosheets are synthesized by Modified Hummer's method, which is similar to the earlier reports [4, 5]. The RGO nanosheets were mixed with N-Methyl-2-pyrrolidone (NMP) and subsequently drop casted over the ZnO nanosheets to improve the thermal behavior of ZnO. Prior to the drop casting, Ag electrodes were taken out with Cu wires for the electrical measurement purpose. Surface morphology analysis was examined by field emission- scanning electron microscopy (FE-SEM) for the RGO coated ZnO nanosheets. Figure 1 (a & b) shows the higher and lower magnification images of RGO coated on ZnO nanosheets. In this view, vertically standing porous structures are ZnO nanosheets and the horizontal flakes are RGO nanosheets. Schematic diagram of RGO coated ZnO nanosheets based temperature sensor and its original photograph (marked in the image) are shown in Figure 2 (a & b). The RGO decorated ZnO nanosheets based sensor is examined from the temperature environment by using Hot-Cold chamber at tested range of -40 to 80 K. As a result, resistance of the sensor varied to the local electrical changes of the combined effect of RGO & ZnO nanosheets with respect to the applied temperature having sensitivity of about 1.01134 Ω / K, which is improved by two times higher than the previous report [4]. The measured negative temperature coefficient of resistance (NTC) of the sensor is about -2.0485×10^{-3} Ω / Ω / K. Therefore, the improved sensitivity of fabricated temperature sensor open ups a new window for diverse applications of thermal devices.

References

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Figures

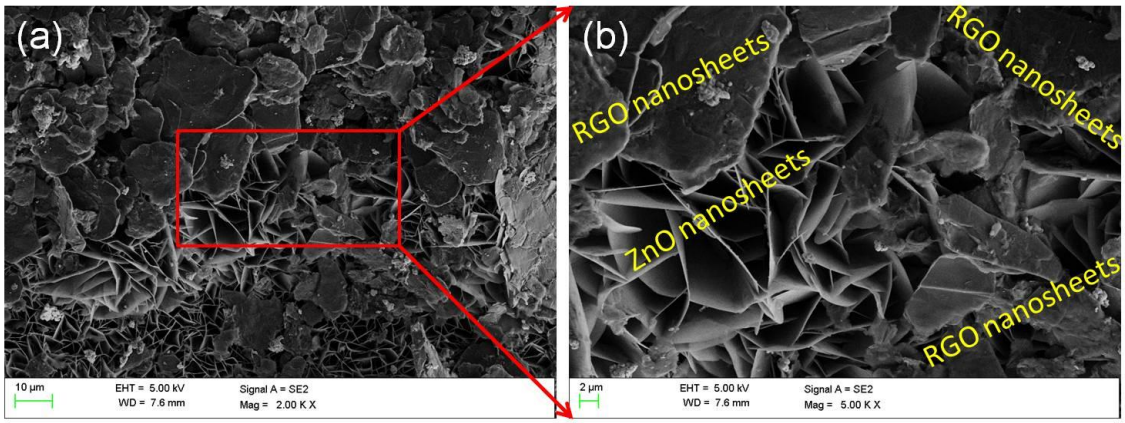

Figure 1: FE-SEM images of RGO coated ZnO nanosheets: (a) Lower magnification view, (b) Higher magnification view.

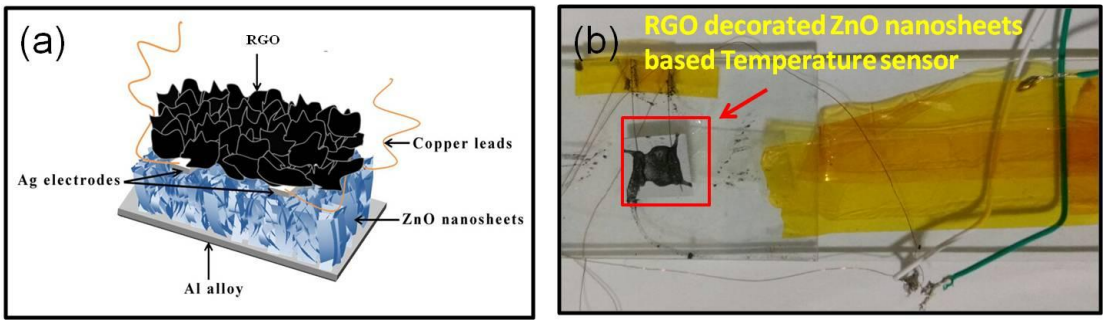

Figure 2: (a) Schematic diagram of RGO coated ZnO nanosheets based temperature sensor, (b) Photograph image of the fabricated temperature sensor.

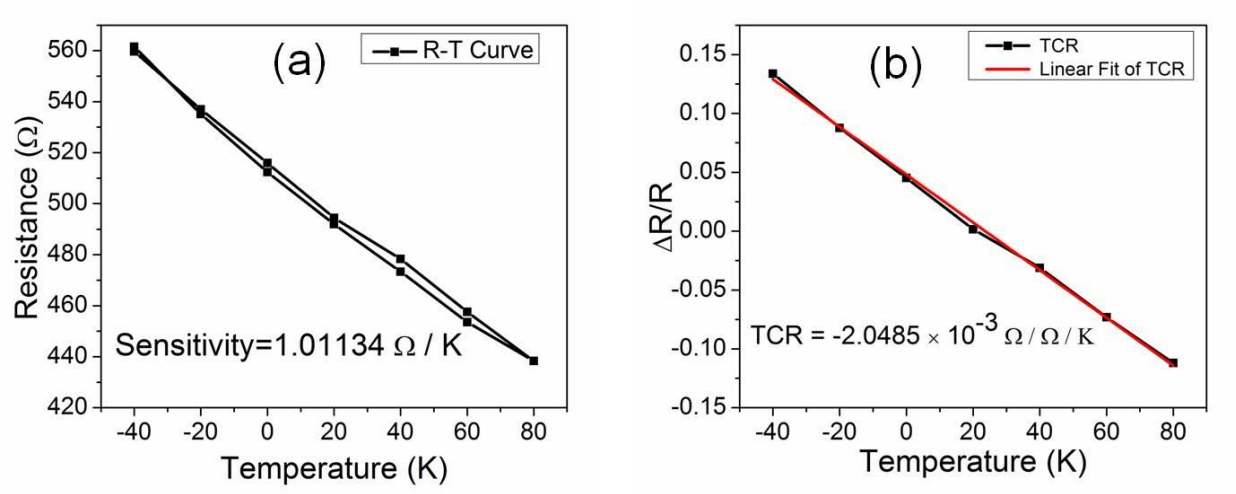

Figure 3: (a) Typical resistance verses temperature response behavior of RGO coated ZnO nanosheets based temperature sensor, (b) Relative change in resistance with respect to temperature.