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LPG Sensing By Graphene/ZnO Quantum Dots Composite

Kailash R. Nemade*, Sandeep A. Waghuley

**Department of Physics, Sant Gadge Baba Amravati University
Amravati, India.**

***Corres. author: sandeepwaghuley@sgbau.ac.in**

Abstract: Gas sensor based on graphene/ZnO QDs composite have been fabricated and tested for LPG sensing. Texture and morphology of composite was analysed through X-ray diffraction and transmission electron microscopy. The optical properties were studied through ultraviolet-visible spectroscopy. The 60 wt.% graphene/ZnO sensor exhibits the highest sensing response than pristine state of graphene and ZnO QDs.
Keywords: LPG Sensing; Graphene/ZnO; Quantum Dots.

Introduction:

Graphene and ZnO are the most promising materials for various modern applications. Wang et al reported the green and facile synthesis route for preparation of graphene nanosheets/ZnO composites for supercapacitor application [1]. Zhang et al demonstrated the supercapacitive application of graphene–ZnO composite film [2]. Liu et al reported the UV-assisted photocatalytic synthesis of ZnO–reduced graphene oxide composites with enhanced photocatalytic activity in reduction of Cr(VI) [3]. Bu et al reported the graphene–ZnO quasi-shell–core composite material as a highly efficient photocatalytic material [4]. Nemade et al reported CO_2 gas sensing application of graphene-zinc oxide quantum dots composites [5].

In the present work, we reported the LPG gas sensing application graphene/ZnO quantum dots composites. The prepared materials were characterized by X-ray diffraction, transmission electron microscope and ultraviolet-visible spectroscopy.

Experimental:

The 60 wt.% graphene/ZnO QDs composite was prepared by previously reported method [5]. The as-synthesized material was characterized by XRD, TEM and UV-VIS analysis. XRD pattern was recorded on Rigaku-Miniflex II diffractometer. To analyse the morphology, TEM image was obtained using Philips Tecnai F-30107. The UV-VIS spectrum of sample was recorded using Perkin Elmer photospectrometer. The sensor fabrication and sensing measurements were done alike as previously reported work [5].

Results and Discussion:

Figure 1 depicts the XRD patterns of the graphene, ZnO and graphene-ZnO QDs composites. The diffraction peaks for graphene and ZnO are in agreement with the PDF card no. 01-0646 and 01-075-1533, respectively. Debye–Scherrer relation was used to calculate the average grain size. The average crystallite size for the composite was found to be 8.7 nm.

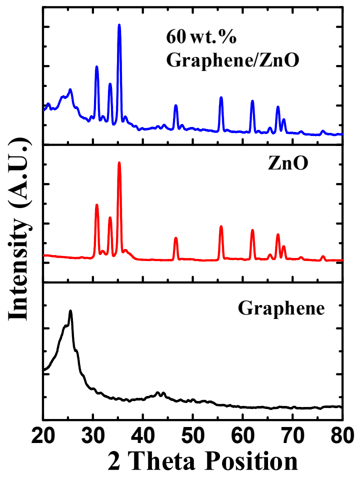

Figure 1. XRD pattern of graphene, ZnO QDs and graphene/ZnO composite.

Figure 2 shows the TEM image of the 60 wt.% graphene/ZnO QDs composite. The TEM image shows that the graphene surface is densely decorated with ZnO QDs.

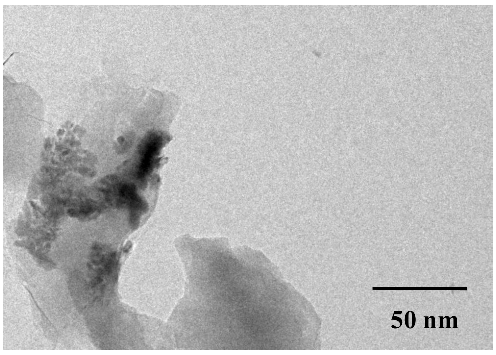

Figure 2. TEM image of graphene/ZnO QDs composite.

Figure 3 shows the UV-VIS spectrum of graphene/ZnO QDs composite. The UV-VIS spectrun of composite shows absorption tail around 375 nm. This presence of absorption in longer UV region suggested that quantum confinment is weak in composite state, than pristein state as the graphene has intence absorption around 268 nm [6, 7].

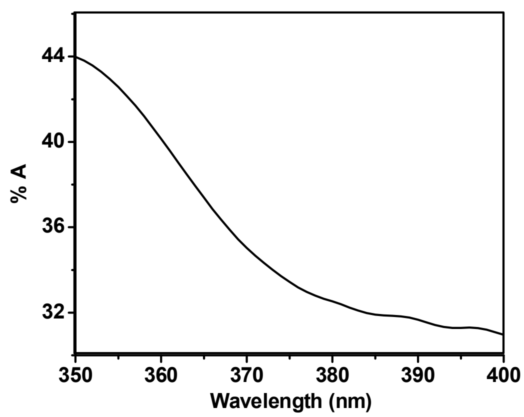

Figure 3. UV-VIS spectrum of graphene/ZnO QDs composite.

Furthermore, LPG sensing responses of sensors were measured as a function of concentration at room temperature (Figure 4). The chemiresistors exhibited an increase in response as a function of LPG concentration. This detection of LPG is may be due to formation of H_2O and CO_2 on its surface, through surface reaction of adsorbed oxygen.

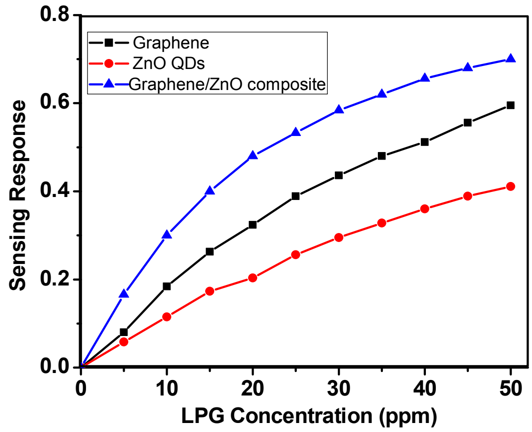

Figure 4. LPG sensing response of graphene, ZnO and graphene/ZnO QDs composite.

Conclusions:

In summary, we made an effort to study LPG sensing properties of graphene/ZnO QDs composite. Sensing response study clearly shows that graphene and ZnO have low sensing response in its pristine state than composite state.

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