Enhanced gas sensing and photocatalytic activity of reduced graphene oxide loaded TiO2 nanoparticles

ABSTRACT

In the present study, we have evaluated the gas sensing and photocatalytic activity of reduced graphene oxide (rGO) conjugated titanium dioxide (TiO2) nanoparticles (NPs) formed by the hydrothermal method. The as-synthesized rGO-TiO2 nanocomposite were characterized for the physicochemical properties such as the nature of crystallinity, functionalization, and morphology by making use of the powder X-ray diffraction, Fourier transform-infrared spectroscopy, and scanning electron microscopy, respectively. On testing the gas sensing properties, we found that the rGO-TiO2 nanocomposite can serve as the chemoresistive-type sensor because of its sensitivity and selectivity towards different concentrations of hydrogen and oxygen at room temperature conditions. However, the rGO-TiO2 sensor's response and recovery speed towards hydrogen and oxygen needs further optimization. Test of photocatalytic activity of TiO2-rGO catalyst for the removal of two model contaminant dyes, RhB and MB showed effective removal, with respective degradation percentages of about 80 and 90% within the first 50 min of irradiation under visible light irradiation. Besides, MB was more effectively degraded using TiO2-rGO than pure TiO2 during the first 30 min of irradiation and this enhanced activity can be attributed to the increased capacity of light absorption, the efficiency of charge carriers separation, and the specific surface area maintained by the rGO-TiO2 nanocomposite to effectively utilize the photo-generated holes (h+) and superoxide radicals (O2−radical dot), responsible for the degradation of the dye. Based on the overall analysis, the formation of rGO-TiO2 nanocomposite can significantly improve the gas sensing and photocatalytic properties of TiO2 NPs and thus can be potential for practical applications in future nanotechnology.

Keyword: Reduced graphene oxide; Titanium dioxide; Hydrothermal method; Gas sensors; Methylene blue dye; Photocatalytic degradation