Synthesis and study of g-C_3N_4 quantum dots for gas sensing

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Graphitic carbon nitride (g-C_3N_4) has recently gained attention due to its exceptional properties, including low cost, large surface area, abundance on Earth, rapid electron transfer, π-π conjugated structure and lack of metals. It is an excellent semiconductor operating in the visible light range. Additionally, it possesses biocompatibility and catalytic abilities [1,2]. It is crucial to emphasize that the outstanding catalytic properties and biocompatibility of g-C_3N_4 make it an ideal material for use in sensors and biosensors. In this study, quantum dots of g-C_3N_4 were produced by hydrothermal treatment (180°C, 16 hours) of a powder that was previously synthesized using thermal polycondensation of urea. These quantum dots were then characterized using scanning electron microscopy (SEM), X-ray photoelectron spectroscopy (XPS), and atomic force microscopy (AFM). The possibilities of using quantum dots to modify sensor layers based on zinc oxide nanorods [3-5] have been investigated. For this purpose, a sensor platform with grown nanorods was placed in water containing quantum dots, which were then soaked for one hour and rinsed with water. The platform was then annealed at 500°C. The gas sensing properties were tested at various temperatures in the presence of volatile organic compounds. The response of the sensors was estimated by measuring the ratio of their resistance in air and in the presence of target gas [6]. It was found that the response of sensor layers modified with quantum dots when exposed to 1000 ppm of isopropyl alcohol at 250°C reached 19. This value is almost 8 times higher than the response of the initial sensor layer of zinc oxide nanorods. This improvement is likely due to the formation of a heterojunctions between g-C_3N_4 and ZnO. Thus, the study demonstrates the efficiency of g-C_3N_4 quantum dots in enhancing the sensitivity and performance of semiconductor gas sensors. Future research will focus on exploring the mechanisms of interaction between g-C_3N_4 and various metal oxides.

References

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