Room-Temperature Sensing Mechanism of GQDs/$BiSbO_4$ Nanorod Clusters: Experimental and Density Functional Theory Study

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Abstract

Creating high-performance gas sensors for heptanal detection at room temperature demands the development of sensing materials that incorporate distinct spatial configurations, functional components, and active surfaces. In this study, we employed a straightforward method combining hydrothermal strategy with ultrasonic processing to produce mesoporous graphene quantum dots/bismuth antimonate (GQDs/$BiSbO_4$) with nanorod cluster forms. The $BiSbO_4$ was incorporated with appropriate contents of GQDs resulting in significantly improved attributes such as heightened sensitivity (59.6@30 ppm), a lower threshold for detection (356 ppb), and quicker period for response (40 s). A synergistic mechanism that leverages the inherent advantages of $BiSbO_4$ was proposed, while its distinctive mesoporous hollow cubic structure, the presence of oxygen vacancies, and the catalytic enhancement provided by GQDs lead to a marked improvement in heptanal detection. This work introduces a straightforward and effective method for crafting sophisticated micro-nanostructures that optimize spatial design, functionality, and active mesoporous surfaces, showing great promise for heptanal sensing applications.