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Highly-sensitive Volatile Organic Compounds Evaluation by $ZnFe_2O_4/ZnSnO_3$ Heterostructures and Their Predictive Grain Quality Monitoring

Kewei Liu[a,b], Zichen Zheng[b,c], Marc Debliquy[a], Chao Zhang[b]

a Service de Science des Matériaux, Faculté Polytechnique, Université de Mons, Mons 7000, Belgium
b College of Mechanical Engineering, Yangzhou University, Yangzhou 225127, PR China
c Chimie des Interactions Plasma-Surface, University of Mons, 20 Place du Parc, 7000 Mons, Belgium

ABSTRACT

As a common metabolite of various agricultural products, 1-octen-3-ol plays a key role in cereal quality evaluation with adverse impacts on human health after inhalation, of which the detectors meeting the detection limit of ppb level that satisfies the request of application have been reported rarely. Herein, $ZnFe_2O_4$ and $ZnSnO_3$ are selected to design heterostructured materials for highly sensitive and selective detection of 1-octen-3-ol gas. The sensing results prove that fine-tuned surface oxygen vacancies and highly-efficient electron transition of the nanocomposites are achieved through modulating the loading amount of $ZnFe_2O_4$, contributing to the significantly enhanced response (40.15 @ 50 ppm), low limit of detection (420 ppb), optimized selectivity and excellent long-term stability (40.786±1.693 @ 50 ppm for 15 days). The enhancement mechanism is explained by a large specific surface area with hollow mesoporous structures, consequent bandgap narrowing and decreased charge transfer resistance, which is further verified through DFT analysis. Moreover, the practical application for the unhusked rice detection is carried out. This work shed light on a new promising candidate for detecting characterized volatile organic compounds released from mildewed rice which may strikingly affect the rice storage industry by simplifying the quality control approach to a great extent.

Keywords: gas sensor; heterojunction; nanocomposite; 1-octen-3-ol; rice mildew