ZnO/RGO Heterojunction based near Room temperature Alcohol Sensor with Improved Efficiency

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ABSTRACT

Systematic optimization of surface engineering (dimensionality) indeed plays a crucial role for achieving efficient vapor sensing performance. Among various semiconducting metal oxides, owing to some of its unique features and advantages, ZnO has attracted worldwide researchers for application in various fields including chemical sensors. Concomitant optimization of the surface attributes (varying different dimensions) of ZnO became a sensation for the entire research family. Moreover, the small thickness and extremely large surface of exfoliated 2D nanosheets render the gas sensing material as an ideal candidate, for achieving strong coupling with different gas molecules. However, temperature is a crucial factor in the field of chemical sensing. Recently, graphene-based gas sensors have attracted attention due to their variety of structures, unique sensing performances and room temperature working conditions. In this work, highly sensitive and fast responsive low temperature (60 ºC) based ethanol sensor, based on RGO/2D ZnO nanosheets hybrid structure, is reported. After detailed characterizations, vapor sensing potentiality of such sensor was tested for the detection of ethanol. The ethanol sensor offered the response magnitude of 89% (100 ppm concentration) with response and recovery time of 12 s/29 s respectively. Due to excessively high number of active sites for VOC interaction, with high yield synthesis process and appreciably high carrier mobility, paved the path for developing future generation, miniaturized and flexible (wearable) vapor sensor devices meeting the multidimensional requirements for traditional and upcoming (health/medical sector) applications. Underlying mechanistic framework for vapor sensing, through such hybrid junction, was explained with the Energy Band Diagram.

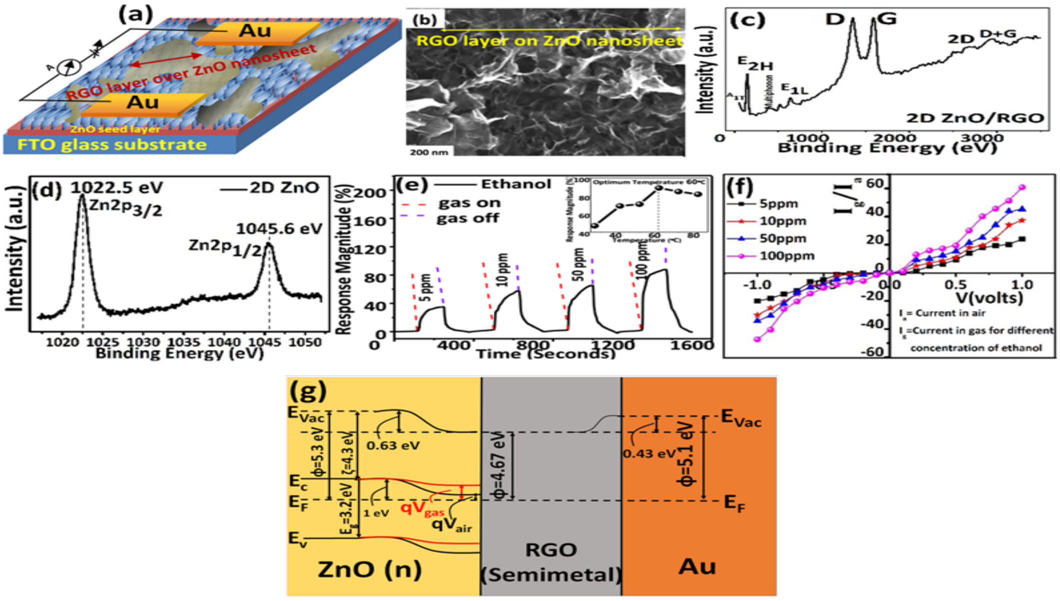

Fig 1(a) A schematic representation of the hybrid device structure (b) FESEM image of the top view (c) Raman Shift and (d) XPS analysis (Zn(2p)) (e) variation of response magnitude for different concentrations at optimum temperature (inset shows the response magnitude variation for 27 to 80ºC) (f) Ratio of current (I_g/I_a) in presence of different concentration of ethanol and air, as a function of voltages (g) Energy Band diagram of 2DZnO/RGO