Self-powered active acetylene sensing properties by piezo-plasmonic Ag@ZnO nanoarray

A.S.M. Iftekhar Uddin, Gwiy-Sang Chung

PII: S0167-9317(17)30103-X
DOI: doi: 10.1016/j.mee.2017.03.005
Reference: MEE 10495

To appear in: *Microelectronic Engineering*

Received date: 15 August 2016
Revised date: 26 December 2016
Accepted date: 17 March 2017

Please cite this article as: A.S.M. Iftekhar Uddin, Gwiy-Sang Chung , Self-powered active acetylene sensing properties by piezo-plasmonic Ag@ZnO nanoarray. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Mee(2017), doi: 10.1016/j.mee.2017.03.005

Self-powered active acetylene sensing properties by piezo-plasmonic Ag@ZnO nanoarray

A.S.M. Iftekhar Uddin, Gwiy-Sang Chung*

School of Electrical Engineering, University of Ulsan, 93 Daehak-ro, Nam-gu, Ulsan 44610, Republic of Korea

* Corresponding author.

E-mail address: gschung@ulsan.ac.kr (G.-S. Chung)

ABSTRACT

In this work, low-temperature and flexible self-powered active acetylene (C_2H_2) gas sensing has been realized from the piezo-plasmonic properties of Ag@ZnO nanowire (NW) arrays through visible light modulation. With the assistance of 3.48-21.47 mW cm^{-2} visible light illumination, the piezoelectric output of the Ag@ZnO NW arrays acting as a response signal shows significant improvement over the traditional resistive-type C_2H_2 sensor at room temperature. Photoexcited plasmonic Ag nanoparticles (NPs) favorably modifies the intrinsic properties and increases the carrier density in the sensing surface, resulting in a strong piezoelectric screening effect. Under 12.72 mW cm^{-2} visible light intensity (under 1.3 Hz and 6 N compressive forces), the sensor shows a sensitivity up to 51.7% at 1000 ppm acetylene at room temperature, whereas at 90^{o}C the sensor shows a maximum response up to 83.86%. Under the same condition, an average response time of 87 sec is observed (upto 1000 ppm gas concentration) as well as a broad detection range of 25-1000 ppm and excellent selectivity. The current results demonstrate a feasible approach for developing light modulated, low-temperature self-powered active gas sensors and their potential in smart wearable, handheld, and portable applications.

Keywords

Piezoelectric; Surface plasmon; Self-powered active sensor; Ag nanoparticle; ZnO nanowires; Acetylene