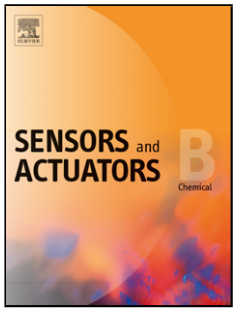

Title: Wide range highly sensitive relative humidity sensor based on series combination of MoS_2 and PEDOT:PSS sensors array

Authors: Ghayas Uddin Siddiqui, Memoon Sajid, Junaid Ali, Soo Wan Kim, Yang Hoi Doh, Kyung Hyun Choi

PII: S0925-4005(18)30632-4
DOI: https://doi.org/10.1016/j.snb.2018.03.134
Reference: SNB 24419

To appear in: *Sensors and Actuators B*

Received date: 26-10-2017
Revised date: 23-2-2018
Accepted date: 22-3-2018

Please cite this article as: Ghayas Uddin Siddiqui, Memoon Sajid, Junaid Ali, Soo Wan Kim, Yang Hoi Doh, Kyung Hyun Choi, Wide range highly sensitive relative humidity sensor based on series combination of MoS2 and PEDOT:PSS sensors array, Sensors and Actuators B: Chemical https://doi.org/10.1016/j.snb.2018.03.134

Wide range highly sensitive relative humidity sensor based on series combination of MoS_2 and PEDOT:PSS sensors array

Ghayas Uddin Siddiqui[1†], Memoon Sajid[1†], Junaid Ali[2], Soo Wan Kim[1], Yang Hoi Doh[3], Kyung Hyun Choi[1,*]

[1, *] Department of Mechatronics Engineering, D201, Engineering Building 4, Jeju National University, Jeju, South Korea. E-Mail: amm@jejunu.ac.kr, +82-10-9898-3713

[2] Department of Physics, COMSATS Institute of Information Technology, Islamabad, Pakistan

[3] Department of Electronics Engineering, Jeju National University, Jeju, Korea

† Both authors can be considered as the first contributing authors of this manuscript

Highlights

- Dual-element transducer design for single target analyte
- Transition metal carbide and polymer combination to enhance performance
- Liquid mechanical exfoliation of MoS2 to achieve 2D flakes and particles
- Detailed investigation of working principle and sensing mechanism
- Fast sensor response and recovery times

ABSTRACT

In this work, a polymeric material poly(3,4-ethylenedioxythiophene) polystyrene sulfonate (PEDOT:PSS) and a two dimensional material molybdenum disulfide (MoS_2) 2D nanoflakes have been employed as the active layers of two separate transducers on a single substrate for the detection of relative humidity. The portion with MoS_2 based active region showed high responsivity towards low humidity levels while PEDOT:PSS based portion responded well to high humidity levels. These two sensing portions were connected in a series combination to fabricate a single humidity sensing device capable to respond to a wide range of relative humidity with very high sensitivity. 2D MoS_2 nanoflakes were obtained by aqueous exfoliation of pristine MoS_2. The transducer electrode pairs were fabricated using reverse offset printing technique on a piezoelectric $LiNbO_3$ substrate. The active thin film of MoS_2 flakes was deposited by Electrohydrodynamic atomization (EHDA) while the thin film of PEDOT:PSS was deposited by SAW-EHDA hybrid system. The fabricated sensor is capable of sensing relative humidity with high sensitivity (50 kΩ/%RH or 800 Hz/%RH) in a wide range of 0% RH to 80% RH. The response and recovery times are also excellent with values of 0.5 s and 0.8 s respectively. This unique approach of combining multiple transducers in a single sensing device can lead to the development of high performance sensors and can solve the current limitations of single transducer based sensing devices.