Kirinyaga University

Tel: +254 701562092, +254 728499650, +254 709742000/30
P.O. Box 143-10300 Kerugoya.

Email: info@kyu.ac.ke
Website: www.kyu.ac.ke

SCHOOL OF PURE AND APPLIED SCIENCES
DIVISION OF RESEARCH, INNOVATION AND GRANTS (DRIG)

A seminar by: ***Dr. Bridget K. Mutuma*** *(bmutuma@kyu.ac.ke)*
Department of Pure and Applied Sciences, Kirinyaga University

Generation of hollow carbon spheres and hollow carbon Sphere/polyvinylpyrrolidone composites for ammonia gas sensors

11TH May, 2021| 9:00 – 10:00 AM
Venue: Virtual

Abstract

Hollow carbon spheres (HCSs) possess good electrical conductivity, tunable textural and structural properties making them useful in a wide range of applications. These HCSs are potential candidates for humidity independent environmental sensing devices for the detection of various chemical vapours. This study reports on the ammonia vapour sensing behaviour of hollow carbon spheres (HCSs), hollow carbon sphere–polyvinylpyrrolidone (HCS/PVP) composite and annealed HCSs. The sensor response was investigated by varying both ammonia concentration and relative humidity. The presence of amorphous domains and oxygenated groups on the pristine hollow carbon spheres resulted in a high relative humidity response. However, the detection of ammonia at high relative humidity using the pristine HCSs was found to be negligible due to the inhibition of ammonia adsorption sites by the high concentration of water molecules. In contrast, a decline in conductivity at high relative humidity was recorded in the HCS/PVP sensors due to polymer swelling and plasticization. Annealing of the HCSs resulted in a decrease in the amorphous domains in the carbon structure and a subsequent increase in the surface area. The topology of the response was determined as a function of these two variables (NH3 and H2O concentration) and analysed by applying a generalized tristimulus analysis to allow the ammonia concentration to be determined

independently of the relative humidity. The pristine HCSs, HCSs/PVP and annealed HCSs sensor responses to 74 ppm NH3 at ambient humidity were 6%, 86% and 196%, respectively. The annealed HCSs exhibited a good ammonia sensitivity to NH3 concentration (74–295 ppm) over a broad range of relative humidity (10–97%); indeed, the values measured were higher than those reported for other nanomaterial-based sensors. This study demonstrates the critical role played by humidity and surface chemistry in the ammonia sensing properties of hollow carbon spheres.

Schematic illustration of hollow carbon-based ammonia gas sensors and their use in various fields.

DRIG COMMITTEE

Contact person: Dr Dickson M Kinyua –DRIG Chairman
(dkinyua@kyu.ac.ke)