Carbon nanofiber-based sensors to detect volatile organic compounds

Pratap Maity, Mudrika Khandelwal*, and Suresh Kumar Garlapati*

IIT Hyderabad, Hyderabad, Telangana, India

mudrika@msme.iith.ac.in and gsuresh@msme.iith.ac.in

Abstract: Carbon nanofiber (CNF) is a promising material for developing low-cost, portable sensors to detect Volatile Organic Compounds (VOCs) due to its excellent properties such as high surface to volume ratio, good electrical conductivity, high sensitivity and selectivity, tunable functional groups by functionalization, etc. However, the reports on the CNF based sensors to detect VOCs selectively are very scarce in the literature. Therefore, we developed CNF based sensors from different biomaterials such as banana fibers (BF) and bacterial cellulose (BC), which led to different morphologies and functional groups in the prepared CNFs. The banana fiber produced the microfiber after carbonization while BC yielded the nanofibrous morphology. CNFs were functionalized by mixed acid treatment. Next the CNFs and the functionalized CNFs (f-CNFs) based dispersed solutions were drop casted on the Au deposited inter-digited electrodes of the PCBs to complete the sensor platform. The sensitivity was measured as a function of current, which changes due to the interaction between the CNFs and VOCs. Interestingly, the sensors have shown dissimilar response to different VOCs such as acetone, ethanol, and isopropanol, which are indicators of spoilage of fruits and vegetables. Several parameters such as sensitivity, selectivity, response & recovery times are discussed here. This study also highlights the recent advances in bacterial cellulose production, the structural changes happened during the carbonization of biomasses, fabrication of the sensor platform and the sensing mechanism. Furthermore, it demonstrates the sensitivity of these CNFs for the detection of VOCs and the potential of developing a portable sensor platform for warehouses.

Keyword: Carbon nanofibers (CNFs), Volatile Organic Compounds (VOCs), Bacterial Cellulose (BC), Banana fiber (BF), Carbonized BC (CBC), Carbonized BF (CBF), Source Measure Unit (SMU)

Details

Pratap Maity	IIT Hyderabad	maitypratap31@gmail.com	2276074
Mudrika Khandelwal	IIT Hyderabad	mudrika@msme.iith.ac.in	
Suresh Kumar Garlapati	IIT Hyderabad	gsuresh@msme.iith.ac.in	