Graphene-Based Porous Top Electrode for Capacitive Relative Humidity Sensor

Unnimaya K S
Amrutha M S, Adhya K M, Shad Bin Siya, Anagha P, Muralidharan M N, Seema A*
Centre for Materials for Electronics Technology, Thrissur, Kerala, 680581, India
**E-mail: seema@cmet.gov.in*

Abstract
Graphene is a promising next-generation conducting electrode material owing to numerous advantageous characteristics, including low sheet resistance, high flexibility, lightweight, and outstanding mechanical properties. Capacitive parallel plate relative humidity sensors require a porous top electrode in order to smoothly allow humidity to enter and exit the sensing layer without sacrificing the electrode's conductivity. Graphene-based conductive inks that are designed to have high porosity and low sheet resistance can be used as the top electrode of relative humidity sensors. The screen-printable graphene conductive ink synthesized in this study has a sheet resistance between 50 to 60 Ω/□, a viscosity of 7 – 15 Pa.s and an adhesion of 3B (as per ISO ASTM standard D3359-B). The capacitive relative humidity sensor developed with this graphene conductive ink as top electrode exhibits good electrical properties with R_s (equivalent series resistance) less than 1kΩ hence, power loss due to heating is lower. The highly porous structure of the ink enables the sensor to have greater sensitivity (> 0.3 pF/%RH), faster response time (≤45 s), and a hysteresis of only ±1%RH. The higher porosity of the prepared ink enables smoother desorption, lower hysteresis, better precision as well as faster recovery. Thus, the sensor provides precise relative humidity measurements during adsorption and desorption. This relative humidity sensor has numerous applications in healthcare, agriculture, environmental monitoring, and improving monitoring air quality monitoring in smart buildings.

References

[1] F. J. Romero, A. Rivadeneyra, M. Becherer, D. P. Morales, N. Rodríguez, Micromachines. 11 (2020) 148.
[2] D. S. Saidina, N. Eawwiboonthanakit, M. Mariatti, 48, (2019) 3428–3450.

Figures

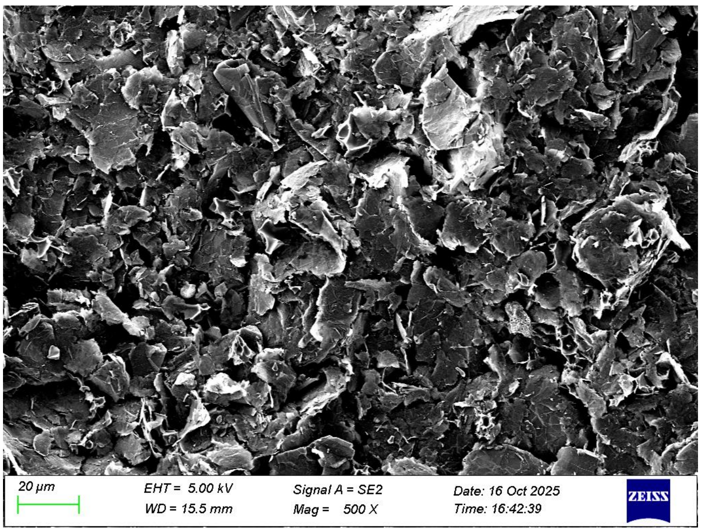

Figure 1: FE-SEM micrograph of the porous graphene conductive ink.