

Porous Graphene Nanocomposites as Pressure Sensors for Human Activity Monitoring

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Realizing the full potential of 2D Graphene requires continued efforts towards application-oriented research¹⁻². The 2D graphene has shown immense potential and usability in the form of polymeric nanocomposites³. These nanocomposites add a new dimension to the already diverse capabilities of Graphene. Flexible and porous Graphene based pressure sensor have been explored but the porosity induction mechanism hinders its wide acceptability and applications⁴. The state-of-the-art porous pressure sensors use a complex, energy inefficient and costly fabrication process⁵. A new and efficient mechanism of porosity induction is needed to overcome these pertinent issues. In this work, we report a new method of porous graphene nanocomposite by developing vapor-channel graphene/PDMS piezoresistive nanocomposites as pressure sensors. Using this new method of porosity induction, we reduce the cost, processing time, resource utilization. The VC-GNP/PDMS shows a 7-fold enhancement in pressure sensitivity ($33.2\% \cdot \text{MPa}^{-1}$), while covering a pressure range up to 2.5 MPa and a two-step gauge factor ($0.66/1.72$). This work stands out in terms of process controllability, reliability and durability to produce porous nanocomposites (not limited to PDMS based) for human body conformal applications. The developed sensor is attached comfortably to the elbow and within the insole. The sensor is capable to sense various elbow positions (A-E), as well as multiple foot impacts of different strength. This work is a preliminary proof of utilizing low-entropy porosity processes to develop highly efficient sensors for human activity monitoring.

References

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Figure

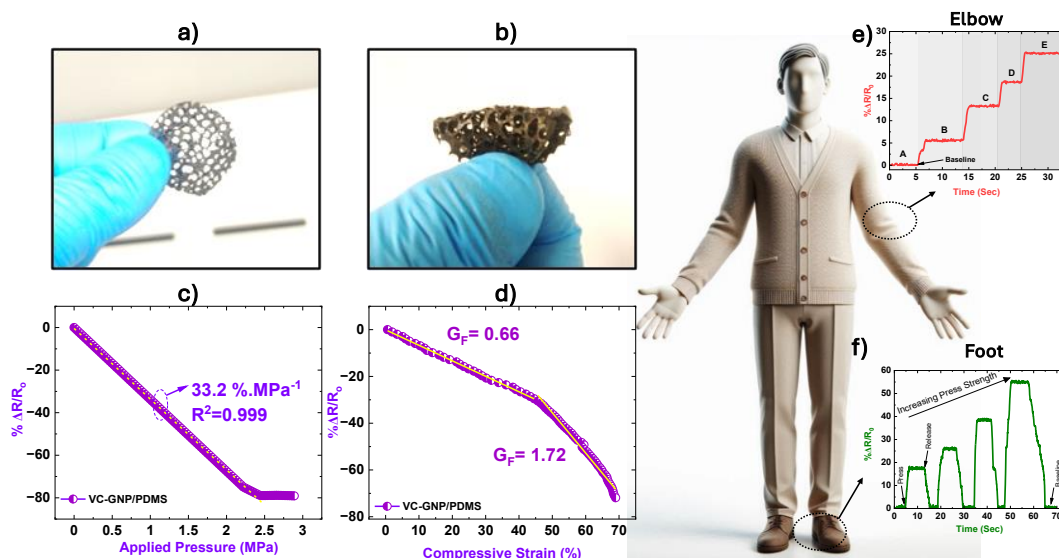


Figure 1: VC-GNP/PDMS based piezoresistive pressure sensor thin films, a) the top view showing the mm-scale pores b) the flexible/bendable nature is shown. The pressure sensor characterization c) sensitivity plot and d) the gauge factor (GF) calculations showing two step GF. The intended application as human activity monitoring are highlighted, e) the sensor is attached to the elbow and resulting time response is shown. f) The sensor is inserted into the insole and heel impacts of different magnitudes are successfully recorded.