Sustainable Fabrication of Graphene Based Sensors

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Abstract

Sensors have become essential components of modern life, contributing to improved safety, increased automation, enhanced energy efficiency, and overall convenience. Their applications span a wide range of fields, including environmental monitoring, healthcare, home and industrial automation, energy management, security, and transportation. Among the emerging materials, graphene and its derivatives stand out as exceptional candidates for sensor development due to their outstanding electrical, mechanical, and chemical properties. The two-dimensional structure provides an extensive surface area, increasing sensitivity to environmental alterations, while their tunable electronic properties allow sensors to be tailored and tailored for specific analytes. Graphene's particularly high electrical conductivity enables efficient electron transport, forming the basis for the development of electrodes or sensors based on changes in conductivity. Furthermore, its mechanical strength and flexibility ensure robust and durable sensors.

In this work, the development of advanced humidity, VOC, temperature, and strain sensors will be presented, with an emphasis on both performance optimization and sustainable manufacturing strategies. The sensing materials, such as graphene oxide (GO), reduced graphene oxide (rGO), and metal oxides, were synthesized using green and recycled methods, underscoring the commitment to environmentally responsible research. The electrodes were fabricated using state-of-the-art writing and printing techniques, incorporating sustainable substrates such as cork and PLA/graphene-based composites. Humidity sensors were fabricated by depositing GO films on novel interconnect electrodes produced through additive manufacturing and laser-induced graphene (LIG) techniques [1, 2]. Gas sensors were developed by integrating metal oxides onto graphene-based electrodes, temperature sensors were based on rGO films, and strain sensors were fabricated from hybrid films of reduced graphene oxide and other 2D materials [3]. Overall, these developments demonstrate a sustainable and innovative approach towards next-generation multifunctional sensors that combine high sensitivity with environmentally friendly manufacturing processes.

References

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Figures

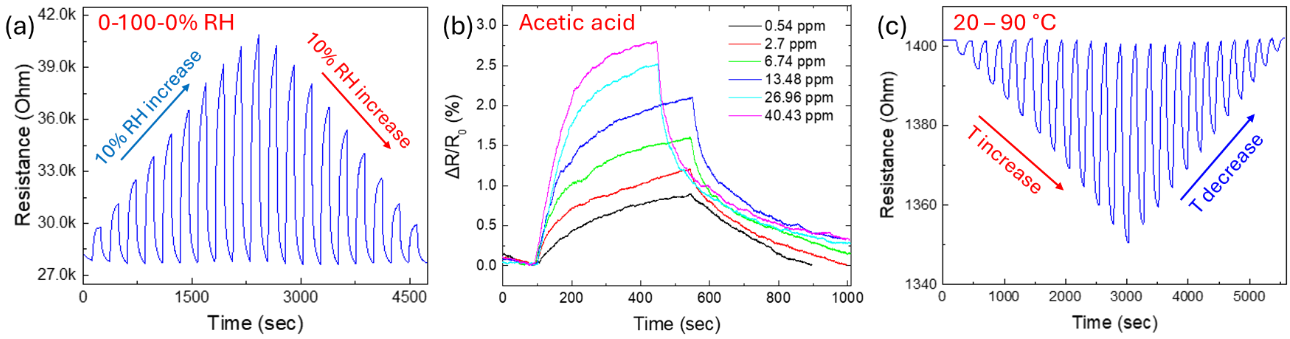

Figure 1: Performance characteristics of graphene-based (a) RH sensor, (b) VOCs sensor and (c) temperature sensor.