Comparative Study of Polymer Matrices in TrGO-Based Composite Sensors for Soil Moisture Detection

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Abstract

Soil moisture monitoring plays a pivotal role in agriculture, contributing to improved plant growth and, thereby, enhanced crop yields. For achieving optimal soil conditions, periodic measurement and maintenance of soil moisture levels are necessary. Controlled irrigation systems facilitate plants to flourish by maximizing growth and vitality. These systems incorporate soil moisture sensors to accurately optimize water utilization in accordance with plant physiological requirements. In this work, we have developed a reliable thermally reduced graphene oxide (TrGO)-polymer-based resistive sensor, which is highly sensitive to soil moisture. The sensor comprises two primary components: a sensor element and a heater element. The soil moisture sensing material utilized is a composite of TrGO and a polymer matrix, such as PVA, PVDF, and PMMA,[1][2][3] which is drop-casted onto a glass substrate with silver paste serving as the base electrode. The heater element employs graphene-based conductive ink, which helps to pre-condition the sensor after each measurement. An increasing sensor response was observed for the PVA/TrGO composite as the soil moisture content increased from 0% to 12% in red soil. A similar trend of comparable response is observed for TrGO composites based on PVDF and PMMA matrices. The as-developed moisture sensor finds a potential application in the real-time soil moisture monitoring for precision agriculture.

References

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Figures

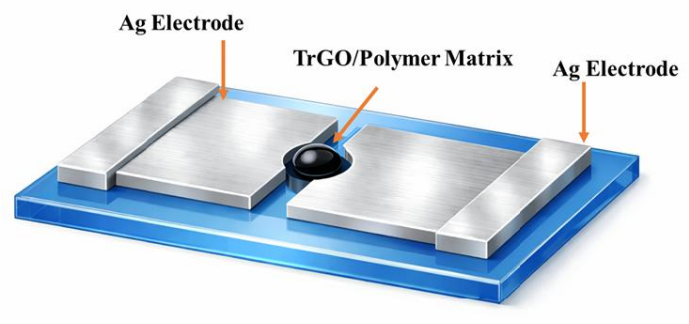

Figure 1: Schematic diagram of the Sensing unit