“Return to the soil” circular soil moisture sensors

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Researchmap https://researchmap.jp/tkasuga?lang=en

Abstract

A sustainable sensing system that combines simplified degradable sensor devices, wireless power supply, and thermal-camera image-based information recognition is developed. The sensor device comprises a biodegradable nanopaper substrate, natural wax, and an eco-friendly tin conductive line. The sensor device emits a thermal signal based on the soil moisture content. The thermal camera simultaneously acquires the soil moisture-content and sensor-device location. Most of the sensor-device components are biodegradable, and the residual components have a minimal adverse impact on the environment. Additionally, the fertilizer component in the substrate promotes plant growth.

Background & Results

Sensor networks comprising small wireless sensor devices facilitate the collection of environmental information and increase the efficiency of outdoor practices, including agriculture. However, the sensor-device installation density of a network is limited because conventional sensor devices must be removed after use.

In this study, we focused on a soil moisture sensor. The proposed sensing system comprised several degradable soil moisture sensor devices, a wireless power supply facility, and a thermal camera to acquire both sensing and location data. Each sensor device comprised a biodegradable paper substrate, a receiving coil composed of a tin (Sn)-printed conductive line, and a carbon-based heater. The installed sensor devices received power from their wireless power supplies, activating their heaters. The soil moisture content was determined using a thermal camera based on the detected hotspots. Following a certain period of usage (e.g., one season), the devices were degraded by microorganisms. Overall, a sustainable high-density sensing system is successfully achieved by combining a degradable sensor device, wireless power supply, and image-acquisition technology.

Significance of the research and Future perspective

The proposed sensing concept introduces a novel direction for realizing hyperdense sensor networks and contributes to the development of social systems that combine sustainability with meticulous environmental management.

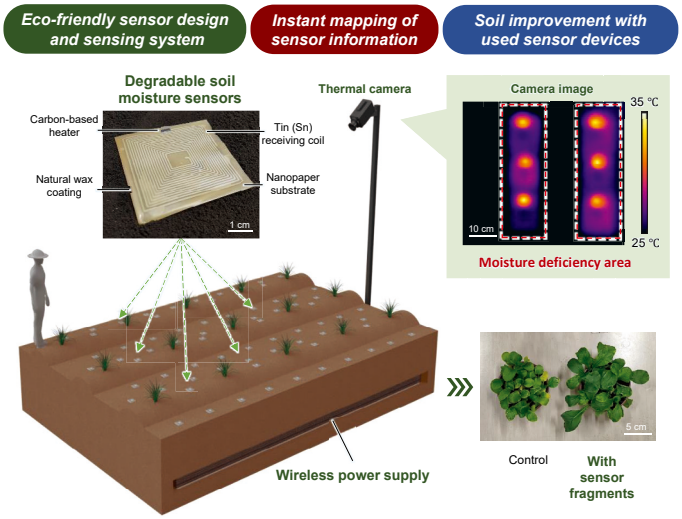

Figure 1

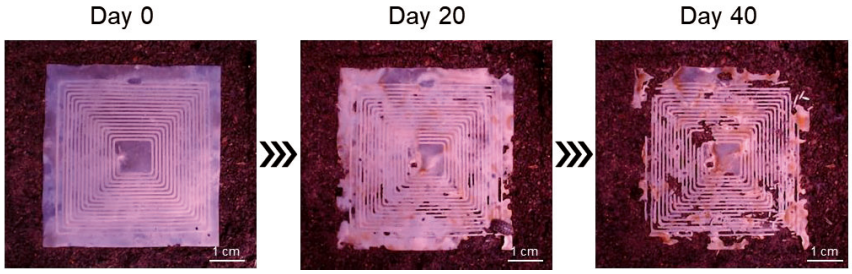

Figure 2

Patent	Japanese Patent Application No. 2023-072321
Treatise	Kasuga, Takaaki et al. Wirelessly powered sensing fertilizer for precision and sustainable agriculture. Advanced Sustainable Systems. 2023, 8, 2300314. doi: 10.1002/adsu.202300314
U R L	https://resou.osaka-u.ac.jp/en/research/2023/20231017_1
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