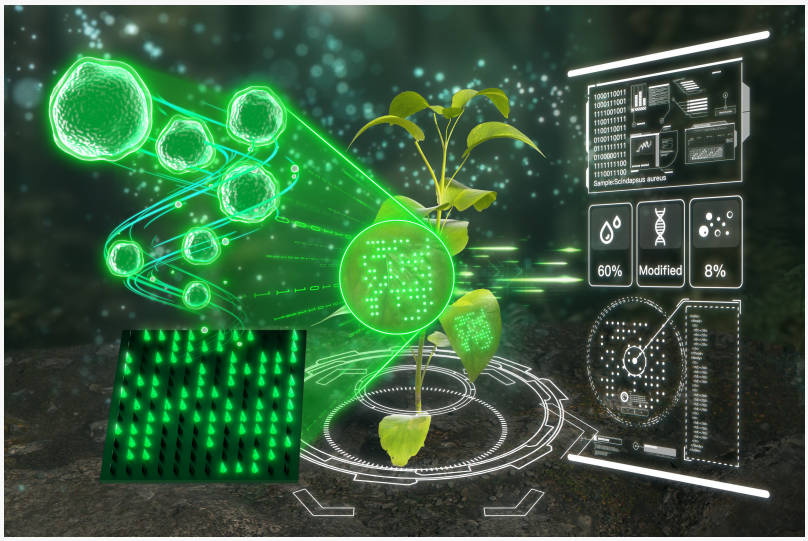
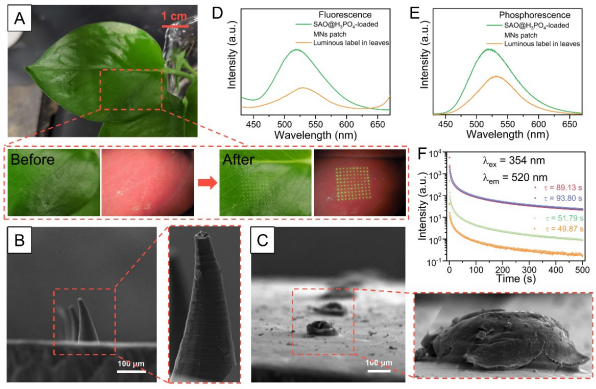
Delivery of Luminescent Particles to Plants for Information Encoding and Storage

USA, September 2, 2024 /EINPresswire.com/ -- In the era of smart agriculture, the precise labeling and recording of growth information in plants pose challenges for modern agricultural production. This study introduces strontium aluminate particles based microneedles (MNs) patches as diverse luminescent labels for information encoding and storage during plant growth. These findings showcase the potential of low-damage luminescent labels within plants, paving the way for convenient and widespread storage of plant growth information.



The construction of a plant information cloud platform using luminescent plant labels



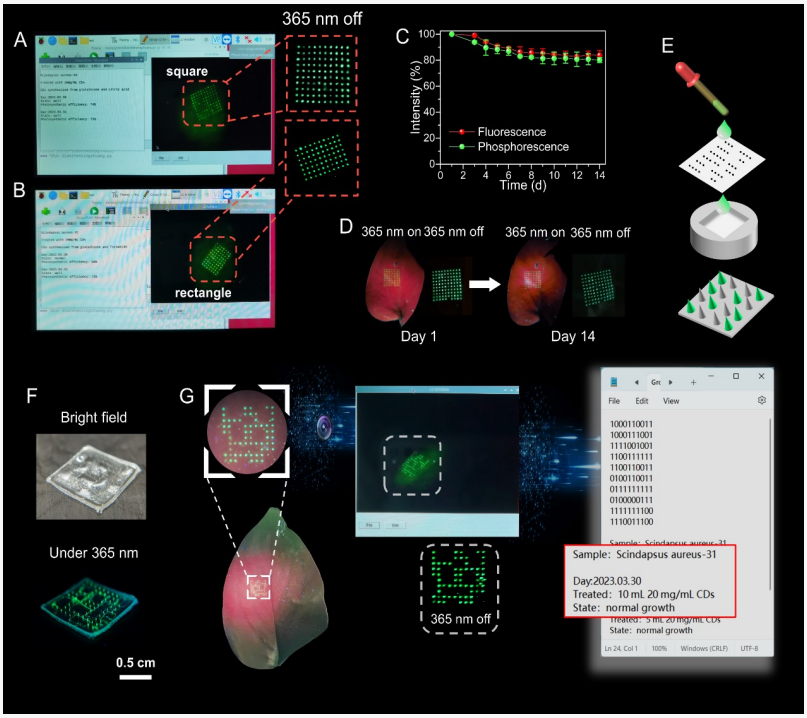
The performance of SAO@H3PO4 embedded within the plant leaf.

Precision agriculture harnesses real-time monitoring, data collection, and intelligent decision support to enhance agricultural efficiency and environmental conditions. In the pursuit of building a smart farm, it is necessary to label and record various life indicators of plants for comprehensive monitoring.

Conventional plant labeling methods involve hanging PVC waterproof tags on plants, but these are susceptible to damage, disorder, and loss. Therefore, the development of an intelligent plant labeling system that ensures reliability, simplicity in recording, reading, and updating, and seamless integration with the IoT network platform is imperative.

In a new paper (doi: https://doi.org/10.1038/s41377-024-01518-x) published in Light Science &

Applications, a team of scientists, led by Professor Bingfu Lei from South China Agricultural University, China and co-workers have developed strontium aluminate particles coated with H3PO4 as luminescent labels capable of spatial embedding within plants for information encoding and storage during growth. The encapsulation with H3PO4 imparts stability and enhanced luminescence to SrAl2O4:Eu2+,Dy3+ (SAO). Using SAO@H3PO4 as a low-damage luminescent label, we implement its delivery into plants through microneedles (MNs) patches.



Diverse luminescent labels for information encoding and storage within the plant.

The embedded SAO@H3PO4 within plants exhibits sustained and unaltered high signal-to-noise afterglow emission, with excellent stability. Inspired by binary information concepts, MNs patches with specific arrangements of luminescent and non-luminescent points are created, resulting in varied luminescent MNs arrays on leaves. An advanced camera system with a tailored program accurately identifies and maps the labels to the corresponding recorded information. These findings showcase the potential of low-damage luminescent labels within plants, paving the way for convenient and widespread storage of plant growth information.

SrAl2O4:Eu2+,Dy3+ with H3PO4 encapsulation (SAO@H3PO4) was used as a long afterglow material, this material exhibits good water resistance and enhanced luminescence, uniquely engineered to be spatially embedded within plants through injection by MN patches. These scientists summarize the dual functionality of SAO@H3PO4 based MN patch:

“Firstly, it serves as a low-impact, luminescent label within plants, maintaining high signal-to-noise afterglow emission and remarkable stability. This enables the creation of QR codes via MNs for efficient, large-scale recording and storage of growth-related data.”

“Secondly, we have pioneered a user-friendly plant label recognition platform. This platform, featuring a Raspberry Pi motherboard and a high-definition camera, can swiftly decode the information encoded in the SAO@H3PO4 labels into a binary format, allowing for rapid recognition and extensive storage of plant growth data.” they added.

“We believe our findings significantly advance the use of solid and micron-sized luminescent materials in precise agriculture, offering a novel approach for data storage and plant

identification. ” the scientists forecast.

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