A Nanobionic Light Emitting Plant
Technology #18248

Applications

The ability to target delivery of nanomaterial to certain regions of plant tissue would be applicable in any endeavor to create biomimetic systems, including light-harvesting apparatuses, photonic devices, and, in this particular instance, an emission source of indirect lighting or near infrared (nIR) communication to external electronic devices. Nanobionic plants may also be used in an agricultural setting as sensors for monitoring chemicals, pesticides, and other growth conditions.

Problem Adressed

Plants possess independent energy sources, negative carbon footprints, and autonomous self-repair, so they provide an attractive platform upon which to bioengineer light-producing systems. Previous attempts to introduce nanomaterial into plants focus primarily on DNA and protein delivery, as well as a small-scale projectile delivery method involving shooting nanoparticles at high pressures into plant cells. However, no large-scale method yet exists for incorporating non-biological material into plants in a targeted fashion.

Technology

This invention involves the targeted delivery of specially engineered nanomaterial to plant leaves by the immersion of the plant in a pressurized water chamber. To demonstrate the viability of this concept, four distinct nanoparticle types containing the proteins and constructs necessary for photon production were introduced to a plant-based system. These nanoparticles target the plant mesophyll, which is naturally high for ATP. The nanoparticles are as follows: a) a silica nanoparticle conjugated to a poly(ethylene glycol) polymer immobilizing luciferase (SNP-Luc), b) a nanoparticle encapsulating the light-releasing compound luciferin, c) chitosan-conjugated nanoparticles encapsulating coenzyme A, which is capable of shifting the emission to any alternative wavelength accessible by resonance energy transfer, including nIR, and d) a nanoparticle conjugated to both silane and Alexa Fluor 488 (SNP-AF) to confirm uptake and localization. They were introduced into plant leaves via a pressurized bath infusion of nanoparticles (PBIN) method that involves the brief submersion of the entire plant into a pressured aqueous chamber of 1.8 bar, at a rate which is sufficient for maximum infiltration without leaf damage. Testing within spinach, arugula, watercress, and kale plants generated bright emission as high as 2.98x1010 photons/second for 30 minutes to 1 hour. The PBIN infusion approach was shown to be capable of being modified to a leaf laminar infiltration of nanoparticles (LIN) approach by the use of a syringe applicator, which can allow for greater spatial targeting specificity, including incorporating visual patterns into plant tissue.

Advantages

- Biological system with negative carbon footprint and autonomous self-repair
- Large-scale nanomaterial delivery method
- Targeting of specific regions of plant tissue
• Applicability to near infrared communication
• Energy-efficient monitoring of crop conditions

Categories For This Invention:

Life Sciences
Biotechnology
Industrial/Energy

Intellectual Property:

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PCT
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Inventors:

Michael Strano
Seon-Yeong Kwak
Juan Pablo Giraldo Gomez
Min Hao Wong

External Links:

Strano Research Group
http://srg.mit.edu/

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