



TECHNOLOGY

Electrical Actuation of Cellular Gene-Expression

OVERVIEW

Background

Transgene-technology is a method that introduces a foreign gene (transgene) into a cell and forces the production of specific proteins that drive desired biological functions, with outcomes such as diagnosis and therapy in humans, improved crop varieties and yields in plants, efficient protein production in bacteria, and other applications. Widespread adoption of the technology in humans and plants is constrained by ethical concerns (humans) and safety fears (plants). Combining transgene-expression with advanced electronics (e.g. wearables, implantable, and point-of-care devices) might help overcome these barriers since electronic devices are external to the organism and produce only temporary effects that can be easily controlled or reversed when needed.

Success of such devices requires precise control over the location, duration, and amount of transgene-expression. This is important because the ability to turn on or turn off transgene expression at distinct tissues or organs at a certain time and modulate the size of the effect enables effective and efficient use of technology to affect outcomes such as therapy, diagnosis, crop yields/adaptation, etc.

Innovative Technology

Researchers at the University of Maryland have developed a novel method that marries bacterial transgene expression with electronics by using a cell's own "machinery" as mediators. The invention enables transgene expression that is tunable by an external electrical power source and, as programmed by the user, can actuate specific or multiple cellular behaviors such as motility, intercellular communication, and illuminating cells due to fluorescent transgene-expression. Such a technology, extendable to various other transgenes of interest to drive desired cellular behaviors, has the potential to revolutionize the use of bio-wearable and implantable devices for therapy, diagnosis, and non-human applications (e.g. plants).

Advantages

- Ability to control transgene expression with the simplicity of an electrical switch
- Control operational parameters such as quantity and duration of the effect
- Improved response time to induce, amplify, and detect transgene expression resulting in faster diagnosis, which in turn enables real-time therapeutic interventions

Applications

- Electrical implants with transgene expression for therapeutic and/or diagnostic ability, e.g. conditional release of insulin in response to blood glucose
- Improvement of crop yields/adaptation, e.g. conditional activation of plant genes to tide over unfavorable climate
- Improved yields of end-products in bacterial fermentation/bioprocessing, e.g. conditional control of bacterial growth and production of fermentation end products to optimize work-day output
- Production of small molecules and proteins using low power microdevices for deploying in remote locations

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Additional Information

INSTITUTION

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PATENT STATUS

Pending

LICENSE STATUS

Contact OTC for licensing information

EXTERNAL RESOURCES

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