The 2023 23rd IEEE International Conference on Nanotechnology

IEEE-NANO 2023 CONFERENCE PROCEEDINGS

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July 2-5, 2023 | Jeju, Korea

TuJT9 Udo

Nanomaterials 8 (Oral Session)

Chair: Jiang, Xiaoning — North Carolina State University

17:20-17:32 — TuJT9.1

Chemo-Driven Pneumatic Soft Actuators: From Nano-Catalysts to Neutralisation Reactions for Oscillating Pneumatic Systems, pp. 936-936.

Villeda-Hernandez, Marcos — University of Bristol

17:32-17:44 — TuJT9.2

Low-Cost Structural Color Surface Decoration with Antiviral Effect, pp. 937-937.

Burak, Darya — Korea Institute of Science and Technology

Rahman, Md Abdur — Singapore University of Technology and Design

Seo, Dong-chan — KIST

Lee, Seung Eun — Korea Institute of Science and Technology

Byun, Ji Young — Korea Institute of Science and Technology

Cho, So Hye — Korea Institute of Science and Technology

17:44-17:56 — TuJT9.3

Designable Ge Quantum Dot Formation with Molecular Dynamics Study, pp. 938-938.

Park, Su Hyun — Postech

Seo, Gyeong Min — Pohang University of Science and Technology

Kim, Jeong Wook — POSTECH

Kong, Byoung Don — Pohang University of Science and Technology (POSTECH)

17:56-18:08 — TuJT9.4

Dual Stimuli-Responsive Hybrid Nanocarrier for Targeted Delivery of Prochloraz in Plant Disease Management, pp. 939-940.

P. Bhat, Mahesh — Agricultural Automation Research Centre, Chonnam National University

Lee, Jae Ho — Agricultural Automation Research Centre, Chonnam National University

Hegde, Vinayak — Agricultural Automation Research Centre, Chonnam National University

Lee, Kyeong-Hwan — Agricultural Automation Research Centre, Chonnam National University

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Dual Stimuli-Responsive Hybrid Nanocarrier for Targeted Delivery of Prochloraz in Plant Disease Management

Mahesh P. Bhat[1], Jae Ho Lee[1], Vinayak Hegde[1], and Kyeong-Hwan Lee[1,2,3]

[1] Agricultural Automation Research Centre, Chonnam National University, Gwangju 61186, South Korea
[2] Department of Convergence Biosystems Engineering, Chonnam National University, Gwangju 61186, Republic of Korea
[3] BK21 Interdisciplinary Program in IT-Bio Convergence System, Chonnam National University, Gwangju 61186, Republic of Korea

Abstract

A recent report claimed an approximate 40% crop loss each year due to fungal infections. Pesticides play a crucial role in safeguarding agricultural yield and boosting crop quality by reducing crop losses. About 30% of crop losses due to pathogens can be prevented by using appropriate pesticides. Thus, pesticides are the most beneficial in improving economic benefits in modern agricultural practices. On the other hand, the Food and Agriculture Organization (FAO) reported approximately 5.1 million tons of agrochemicals are applied in the year 2020 alone to control pests and pathogens. Out of these values, only 0.1% of applied agrochemicals will act on target effectively owing to the drifting of remaining pesticides to the environment which poses a serious threat to human health and the environment [1]. Currently, stimuli-responsive hybrid nanomaterials have attracted much attention due to their ability to achieve on-demand targets. As typical inorganic-organic hybrid materials diatoms (DE) and Ti-MOFs (titanium metal-organic frameworks) nanoparticles are considered promising candidates. Benefits from the environmental friendliness of natural DE and Ti are suitable for application in agriculture applications. This work aims to investigate the efficiency of dual stimuli-responsive prochloraz-loaded DE functionalized Ti-MOF in controlling *Botrytis cinerea* [2]. These nanoplatforms will lead to the usage of low amounts of pesticides to achieve high efficiency. The high surface area and functionality of DE accommodated the Ti-MOF with an average particle size of 452 nm on the surface. The developed ultra-high surface area of 731 m^2/g for Ti-MOF@DE nanoplatform accommodated prochloraz with a high fungicide loading capacity of 39%. The developed nanoplatforms are analysed using various techniques to confirm their structural and functional properties. Further, the coating of pectin forms an adhesive layer on the surface of prochloraz-loaded DE@Ti-MOF to achieve enzyme-responsive release [3]. During the fungal infection in plants, there release the enzyme pectinase, which readily degrades the pectin layer of the nanoplatform thereby increasing the efficiency of pesticide release. Furthermore, biopolymer alginate was used as a capping agent to protect the encapsulated prochloraz pesticide from degradation. The pH change and enzyme secretion caused by *B. cinerea* infection could trigger degradation of the biopolymer layer and pectin layer for the sustained release of prochloraz that would induce the death of pathogens. Further, the physiochemical properties, release behavior, antifungal activity, and biosafety studies of the hybrid materials are systematically investigated. The hybrid nanocomposite was found to be highly efficient in preventing gray mold fungal disease in tomato plants caused by *B. cinerea*. Therefore, the developed hybrid nanoplatform could be a promising tool in replacing traditional pesticides thereby limiting the hazards to the environment.

ACKNOWLEDGMENTS

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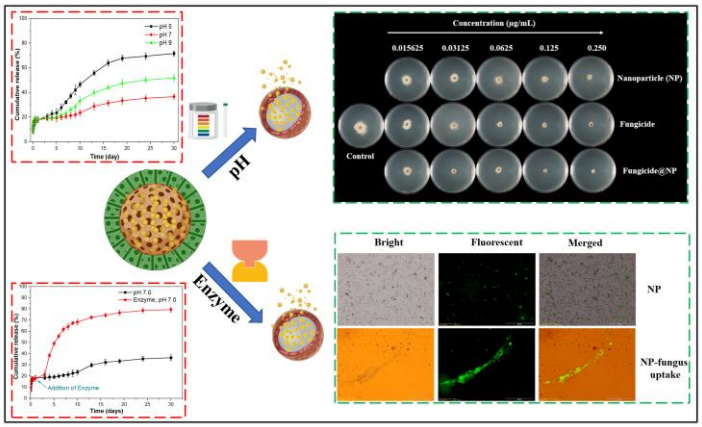

Figure 1. Schematic illustration of dual stimuli responsive prochloraz release from hybrid nanocomposite, their antifungal activity and nanoparticle uptake studies.