

Activating Redox Biocatalysis by Light-Induced Electron Transfer

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Abstract

Biocatalytic photosynthesis combines the distinctive characteristics of redox biocatalysis and photocatalysis for solar-to-chemical conversion. Photocatalytic materials harvest renewable solar light to activate oxidoreductases that offer nature-inspired routes for sustainable chemical synthesis with unparalleled reaction selectivity. Oxidoreductases catalyze redox transformation of substrates by exchanging electrons at the enzyme's active site, often with the aid of electron mediator(s) as a counterpart. Recent progress indicates that photoinduced electron transfer using organic (or inorganic) photosensitizers can activate a wide spectrum of redox enzymes to catalyze fuel-forming reactions (e.g., H₂ evolution, CO₂ reduction) and synthetically useful reductions (e.g., asymmetric reduction, oxygenation, hydroxylation, epoxidation, Baeyer–Villiger oxidation). In this talk, I will describe the concept of light-driven redox biocatalysis and recent advances in the emerging field.

Keywords: Natural photosynthesis, Artificial photosynthesis, Redox enzymes

CURRICULUM VITAE



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Education History

[Doctorate]	1995–1999	Chemical Engineering, Pohang University of Science and Technology (POSTECH)
[Master]	1993–1995	Chemical Engineering, Pohang University of Science and Technology (POSTECH)
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Professional Background

2015–present	Director, Creative Research Initiative, National Research Foundation
2012–present	Professor, Department of Materials Science and Engineering, KAIST



Selected Awards and Honors

1. 2024 Technology Innovation Award (Gran Prix), KAIST
2. 2019 Academic Excellence Award,
Korean Society for Biotechnology and Bioengineering
3. 2013 Prime Minister's Award, Republic of Korea
4. 2012 Scientist of The Month Award, Republic of Korea



Selected Publications

1. J. Jang, S. Joo, J. Yeom, Y. Jo, J. Zhang, S. Hong, C. B. Park "Lateral piezoelectricity of Alzheimer's A β aggregates" *Advanced Science*, vol. 11, pp. 2406678, 2024
2. C. H. Lee, J. Kim, C. B. Park "Z-Schematic artificial leaf structure for biosolar oxyfunctionalization of hydrocarbons" *ACS Energy Letters*, vol. 8, pp. 2513-2521, 2023
3. J. Kim, J. Jang, T. Hilberath, F. Hollmann, and C. B. Park "Photoelectrocatalytic biosynthesis fuelled by microplastics" *Nature Synthesis*, vol. 1, pp. 776-786, 2022
4. J. Yoon, H. Jang, M-W Oh, T. Hilberath, F. Hollmann, Y. S. Jung, and C. B. Park. "Heat-fueled enzymatic cascade for selective oxyfunctionalization of hydrocarbons" *Nature Communications*, vol. 13, pp. 3741, 2022
5. J. Jang and C. B. Park. "Magnetoelectric dissociation of Alzheimer's β -amyloid aggregates" *Science Advances*, vol. 8 (issue 19), pp. eabn1675, 2022