



Photobiocatalysis for Redox-Reactions

Replacing sacrificial co-substrates with just light and water? Photobiocatalysis couples the selectivity of enzymes to light-driven generation of reducing power (NAD(P)H) and oxygen – enabling greener redox chemistry under mild conditions and opening a practical route for fine chemicals and pharma intermediates/APIs.

BACKGROUND

Photobiocatalysis merges biocatalysis with light to unlock sustainable redox chemistry – either via photosensitized/cofactor regeneration or via photosynthetic whole-cell systems that provide reducing equivalents from water and light. While the promise is strong, industrial translation has, so far, been limited by predictable hurdles: uneven light distribution and self-shading at higher biomass, oxygen-transfer limits for oxidative enzymes, and inefficient electron partitioning that diverts photosynthetic reductants away from the target reaction.

TECHNOLOGY

acib offers

- Advanced photobiocatalytic processes using novel reactor concepts (e.g., thin-path flat-panel photobioreactors) to maintain effective illumination while increasing volumetric productivity.
- Rational management of photosynthetic electron flux by introducing strong heterologous electron sinks and identifying bioenergetic bottlenecks (NADPH supply and NADPH/NADP⁺ balance), enabling targeted strain and process optimization.
- Overcoming oxygen limitations in oxyfunctionalizations by coupling monooxygenases to photosynthetic O₂ evolution in continuous-flow coil/mesoreactors – enabling oxygen-self-sufficient operation and high space-time yields under well-defined, scalable conditions.

OFFER

We (co-)develop tailored photobiocatalytic routes for your target transformation (reductions and/or oxyfunctionalizations). Scope includes catalyst/host selection (cyanobacteria or enzyme-based concepts), pathway and electron-flux engineering, reactor and illumination design for scale (flat-panel and continuous-flow formats), analytics and KPI tracking (rate, selectivity, robustness), and a transfer-ready process package.

Project IP can be fully transferred to the company partner; we are happy to discuss details under NDA and provide a tailored plan. Just share your target transformation(s), desired scale and productivity, acceptable solvents and temperatures, regulatory constraints, and any prior biocatalytic or photocatalytic trials. We will then propose a concise workplan with clear milestones and success criteria, tailored to your application.

EXPERTS

Prof. Dr. Robert Kourist

DEVELOPMENT STATUS:

Technology Readiness Level 4
(Technology Validated in Lab)

KEY WORDS

- Photobiocatalysis
- Light-Driven Biotransformations
- Photoenzymes
- Light-Powered Cofactor Regeneration
- Continuous-flow Reactions
- Cyanobacterial Whole-Cell Biocatalysis
- Heterologous Expression, Redox Balancing
- Oxyfunctionalization, Green Chemistry
- Stereoselective Oxidation, Stereoselective
- Reduction, CO₂-to-Chemicals Coupling
- Enzymatic Polymer Recycling, Plastic
- Biorefinery, Mixed Plastic Waste Valorisation
- Circular Polymer Economy, Sustainability

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