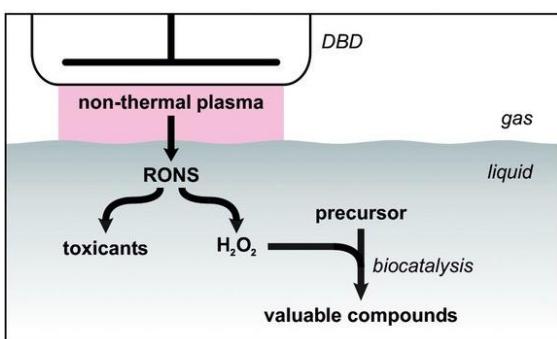


Plasma Biocatalysis

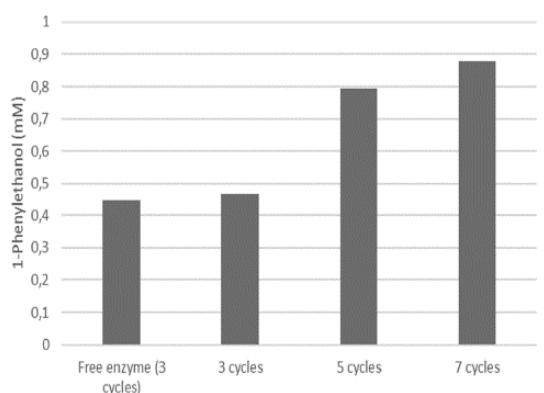
Enzymatic Oxidation of Organic Compounds Using Discharge Plasma

Invention

Enzymatic reactions offer the possibility to synthesize new molecules with high selectivity and turnover. Of particular interest are regio- or even stereo-selective oxidation reactions in order to obtain high value compounds. Peroxygenases are valuable biocatalysts to achieve this goal since they use H₂O₂ through the so called “peroxide shunt pathway”, eliminating the need for expensive electron donors, such as flavins or nicotinamide cofactors. However, the industrial application of peroxidases or peroxygenases is limited due to their partial or complete inactivation in the presence of higher concentrations of peroxides. Several strategies have been developed in order to supply low concentrations of H₂O₂ in situ. However, all of these known methods are either inefficient or require the addition of extra components to the reaction, making them less efficient and more expensive.



General scheme of the plasma-driven H₂O₂ generation and the subsequent biocatalysis.



Concentration of 1-phenylethanol after different cycles of DBD plasma treatment either with free or immobilized enzyme of UPO

A patent application has been filed; WO 2020/007576 A1.

Relevant Publications

- A. Yayci, A. Baraibar, M. Krewing, E. Fernandez Fueyo, F. Hollmann, M. Alcalde, R. Kourist, J. Bandow, Plasma-driven in situ production of hydrogen peroxide for biocatalysis, *ChemSusChem* 13, 2072 (2020).
- A. Yayci, T. Dirks, F. Kogelheide, M. Alcalde, F. Hollmann, P. Awakowicz, J. Bandow, Microscale atmospheric pressure plasma jet as a source for plasma-driven biocatalysis, *ChemCatChem*, DOI 10.1002/cctc.202001225 .

An invention of Ruhr-Universität Bochum.

presence of higher concentrations of peroxides. Several strategies have been developed in order to supply low concentrations of H₂O₂ in situ. However, all of these known methods are either inefficient or require the addition of extra components to the reaction, making them less efficient and more expensive.

The present invention provides a solution to this challenge. A plasma device is employed to produce H₂O₂ in an aqueous solution in situ. The “activated” solution is guided to immobilized peroxidases or peroxygenases where the actual enzymatic oxidation of the substrate takes place. The inventors can show that selectivity of the enzymes is retained and stability of the immobilized enzyme is high.

Employing UPO from the fungus Agrocybe aegerita as oxygenase and ethylbenzene as substrate, the inventors could show feasibility of this approach.

Commercial Opportunities

The present invention is available for licensing and further co-development.

Current Status

The invention has been validated in a relevant environment and achieves a TRL 4.

Competitive Advantages

- New access to enzymatic oxidations in aqueous solution
- Selectivity of enzyme is retained
- Control over H₂O₂ concentration through control of plasma discharge
- Works with immobilized enzyme

Technology Readiness Level

1 2 3 4 5 6 7 8
Technology validated in lab

Industries

- Chemistry
- Pharmaceutical compounds
- Fragrances

Ref. No.

5221

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