

Features

The RAMOS® enables an 8-fold parallel online measurement of respiratory activities and process control under sterile conditions in 250 ml and 500 ml flasks.

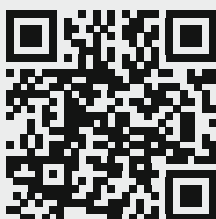
- » Temperature control (+30...+50 °C, with cooling system 5 °C below RT)
- » Determination of OTR, CTR, RQ and μ_{\max}
- » $k_L a$ determination
- » Fed-Batch with feeding system
- » Control gas phase (O₂, CO₂) in combination with gas mixing station Gmix™
- » Phototrophic cultivation in combination with exposure module CultiLux™

Fields of application

- » Process development and optimization (early detection of oxygen and substrate limitation or product inhibition)
- » Media optimization (investigation of substrate affinity)
- » Stem screening and optimization (e. g. enzyme production for biofuels)
- » Fermentation validation
- » Stability testing and quality control (e. g. stability of mammalian cell lines)
- » Toxicity studies and degradation studies (e. g. wastewater treatment)
- » Process balancing and quantification (e. g. carbon accounting)
- » Determination of kinetic growth and process parameters (μ_{\max} , K_s , $k_L a$)

References

- [1] R. Krüger, "Praktikumsversuch RAMOS®", HiTec Zang GmbH, 2005
- [2] J. Pfannebecker, C. Schiffer-Hetz, J. Fröhlich, B. Becker, "Culture medium optimization for osmotolerant yeasts by use of a parallel fermenter system and rapid microbiological testing", Journal of Microbiological Methods, vol. 130, pp. 14-22, 2016
- [3] M.L. Socher, F. Lenk, K. Geipel, C. Schott, J. Püschel, C. Haas, C. Grasse, T. Bley, J. Steingroewer, "Phototrophic growth of *Arthrospira platensis* in a respiration activity monitoring system for shake flasks (RAMOS®)", Engineering in Life Sciences, vol. 00, pp. 1-9, 2014
- [4] K. Geipel, M.L. Socher, C. Haas, T. Bley, J. Steingroewer, "Growth kinetics of a *Helianthus annuus* and a *Salvia fruticosa* suspension cell line: Shake flask cultivations with online monitoring system", Engineering in Life Sciences, vol. 13, pp. 593-602, 2013



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Bioprocess optimization in shake flasks



Universal measuring system

RAMOS® (Respiration Activity Monitoring System) has established itself worldwide as the standard for online determination of the respiratory activity of pro- and eukaryotic cultures in shake flasks.

In numerous processes investigated so far RAMOS® has helped to gain key knowledge and has given the decisive impulse for development work which in some cases took many years. RAMOS® provides the really meaningful metabolic parameters O_2 - (OTR) and CO_2 -transfer rate (CTR), as well as the derived parameters respiratory quotient (RQ) and the maximum specific growth rate (μ_{max}).

Cell physiology

With the help of the measurement curves, basic biological phenomena can be reliably detected during process development in the shake flask, such as substrate/oxygen limitation, substrate and product inhibition, polyauxia, fermentation, overflow metabolism, etc. [1].

Media optimisation

A typical screening application with a correspondingly high number of trials is media optimization. In the work of Pfannebecker et al. [2] the RAMOS® was used, for example, for the development of a nutrient medium for the qualitative detection of osmotic tolerant yeasts. Using the online evaluation of the CTR, it was possible to determine which media components significantly increase CO_2 production, thus reducing the detection time.

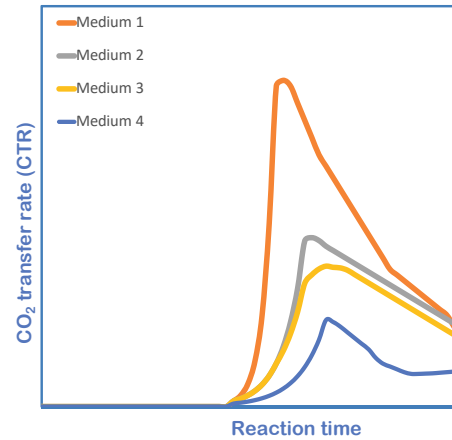
Phototrophic cultivation

Phototrophic organisms (PO) represent an enormous production potential in, for example, cosmetics and pharmaceuticals. POs play a particularly important role in biofuels. For the optimization of the cultivation, the illumination conditions as well as the gas transfer plays an important role. In the work of Socher et al. [3], the RAMOS® was used to quantify metrologically, using *Arthrospira platensis* as an example, how the O_2 production rate depends on light exposure.

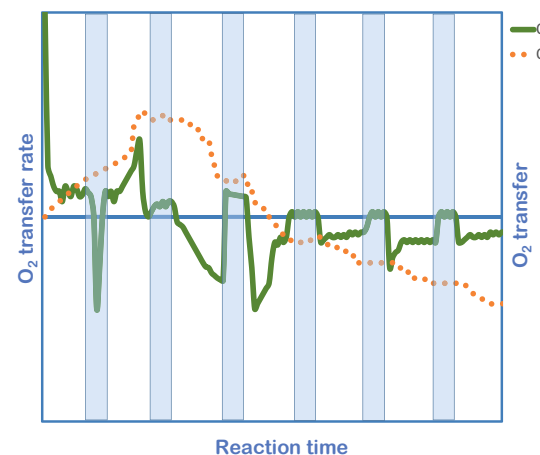
Cell cultures

The article by Geipel et al. also deals with plant cells, but using in vitro cultures of sunflower and sage [4]. In this case the RAMOS® was used as screening system. Both a successful transfer of a sunflower suspension culture into the RAMOS® shake flask system could be shown, as well as the fact that the measurement of the respiration activity is a qualified tool for the screening of plant in vitro cultures.

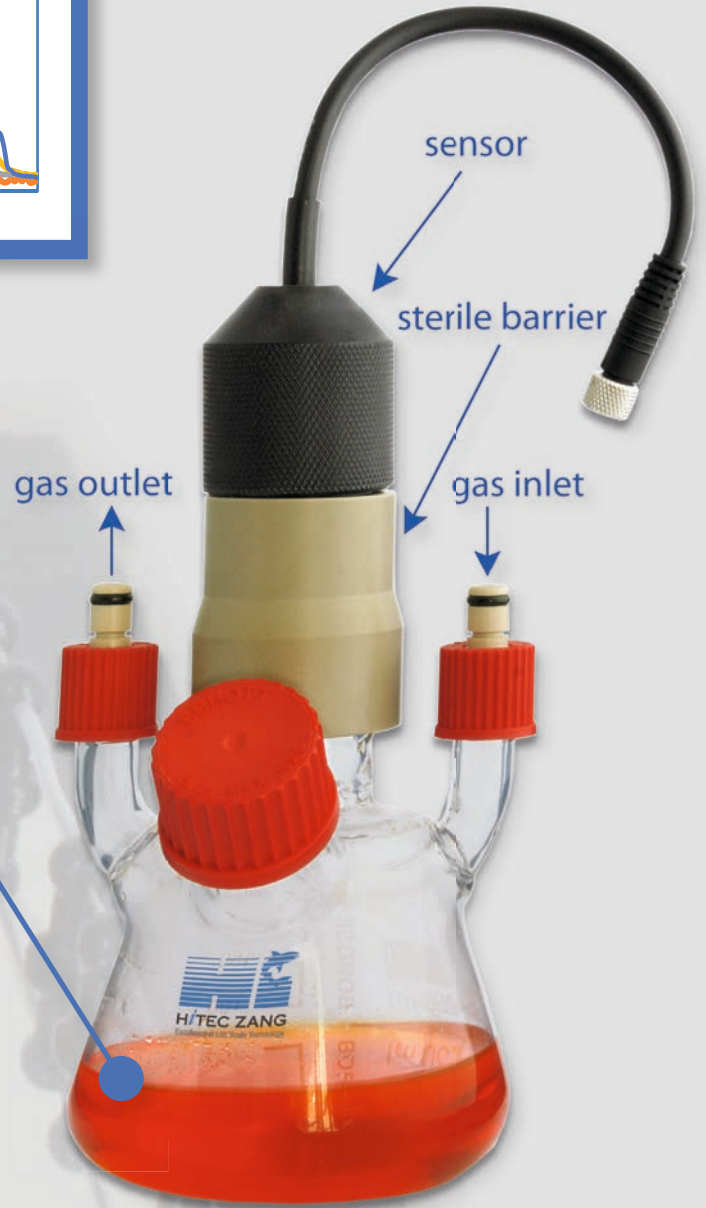
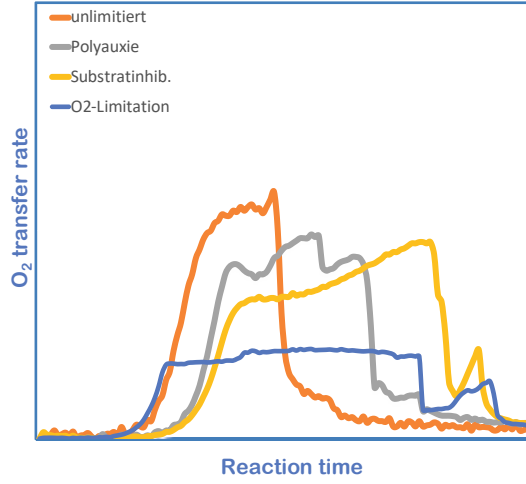
2. Media Opti



3. Phototrophic Cultivati



1. Cellular Physiological Phenomena



4. Plant Cultures

