Photon Systems Instruments

PSI NEWS ISSUE 26

PROFESSIONAL INSTRUMENTS FOR PLANT SCIENCE, BIOTECHNOLOGY AND AGRICULTURE

COMPACT GAS ANALYSER MS GAS-100

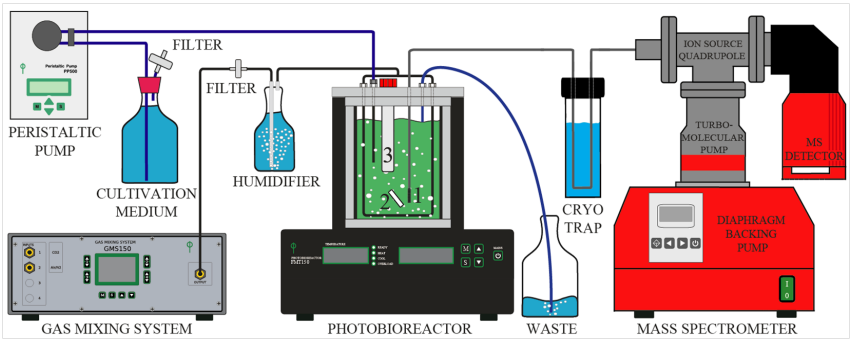
Rapid and accurate real-time analyses of gases and volatiles in liquid and/or gaseous environment

- Mass sensitive spectrometer
- Highly efficient vacuum system
- Unique Stirling cooler water trap
- Precise capillary inlet

NEW!

Key Features

- Real time, long-term analyses of multiple gases and volatile species by a single device
- Accurate, sensitive and rapid measurements
- Membrane based inlet or needle valve inlet for atmospheric measurements and/or special gaseous and liquid applications
- Highly efficient removal of water molecules by Stirling cooler water trap for significant enhancement of ion source lifetime
- Configurable for gas exchange analyses on whole plants, leaves or on cell suspensions
- User friendly software interface



Scheme of MS GAS-100 connections with photobioreactor

Technical Specifications

- **Ion source**
  - Electron ionization
  - Two independent filaments
- **Quadrupole mass analyzer**
  - Mass scales available: 1–100, 1–200 and 1–300 amu
- **Detector types**
  - Faraday: sensitivity < 10 ppm
  - Secondary Electron Multiplier (SEM): Sensitivity < 100 ppb
  - Response Time < 20 s
- **Stirling cooler water freezing trap**

Applications

- **Gas exchange kinetics analysis** (CO_2, O_2)
- **Nitrogen fixing species** (N_2, C_2H_2)
- **Biofuels** (H_2,CH_3CH_2OH, hydrocarbons)
- **Photorespiration with labeled** $^{18}O_2$
- **Isotopic distribution analysis**
- **Air and water pollution**
- **Gas pollutants** (CH_4, H_2S, NO_x, SO_2, CS_2, CO, …)
- **Volatile organics, solvents**

For additional information, please contact us at info@psi.cz

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Are you interested in a complete Gas Analysis for your research?

EXPLORE THE NEW MASS SPECTROMETER **MS GAS-100**

Light compensation point of cyanobacterium *Synechocystis* wild type (WT) 6803

The light compensation point is the amount of light intensity on the light curve where the rate of photosynthesis exactly matches the rate of respiration.

Method

The pre-cultivation of *Synechocystis* WT 6803 was performed in the Photobioreactor FMT 150 (PSI, CZ) under the red actinic light of 150 µmol m^{-2} s^{-1}. The compensation point was determined while the stationary phase was reached. After dark adaptation (30 min) the samples were irradiated with red light intensities of 10–1000 µmol m^{-2} s^{-1}. Produced oxygen was monitored with MS GAS-100 directly in cell suspension in the real time. The light compensation point was determined as the intersection point with x-axis (intensity of red light) when the oxygen production and consumption were in equilibrium.

Results

The oxygen production rates of Synechocystis WT 6803 suspension are shown in *Figure 1.* The compensation point was found to be around 22 µmol m^{-2} s^{-1}.

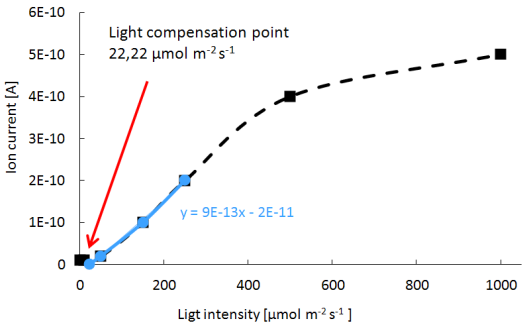

Figure 1 / Photosynthetic release of oxygen (expressed as ion current) by *Synechocystis* WT 6803 suspension irradiated with red light of 10, 50, 150, 250, 500 and 1000 µmol m^{-2} s^{-1}

References:

- Zavřel T. *et al*, 2016. A quantitative evaluation of ethylene production in the recombinant cyanobacterium *Synechocystis* sp. PCC 6803 harboring the ethylene-forming enzyme by membrane inlet mass spectrometry. *Bioresource Technology* 202, p. 142–151.
- Zavřel T., Červený J., Knoop H., Steuer R., Optimizing cyanobacterial product synthesis: Meeting the challenges. *Bioengineered* 2016, 7:6, 490-496.

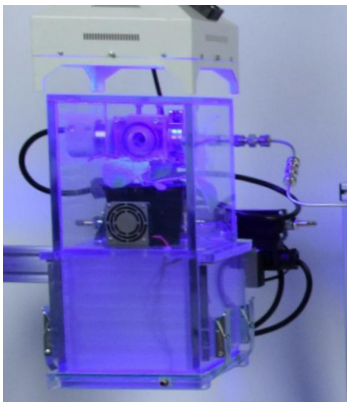

Figure 2 / The gasometric chamber – close system for the gas exchange measurements of the entire plant

Gas exchange measurements in higher plants

The plant gas exchange measurements are based on the assessment of water vapor and carbon dioxide and oxygen concentrations changes. A gas analyzer with a mass detection allows to determinate extremely low amounts of the measured exchanged gases.

Method

The gas exchange analyses of tomato were performed for the whole plant closed in a gasometric chamber (*Figure 2*). Two mass spectrometers were used: **MS GAS-100** with needle valve inlet (PSI, CZ) and **OmniStar** with heated capillary inlet (Pfeiffer Vacuum, Asslar, DE).

Measured values were expressed as gas amount changed per second per plant. **Li6400XT** with open leaf-clip chamber and IRGA detection (Li-Cor, Lincoln, USA) was used as common reference method.

Results

All tested instrument setups detected comparable physiological response expressed as the light curve shape for the identical tomato plant (*Figure 3*). Moreover, CO_2 concentrations determined via mass spectrometer-gasometric chamber setups showed highly comparable results with the standard deviation two-fold lower compared to IRGA detection and thereby proved higher reproducibility.

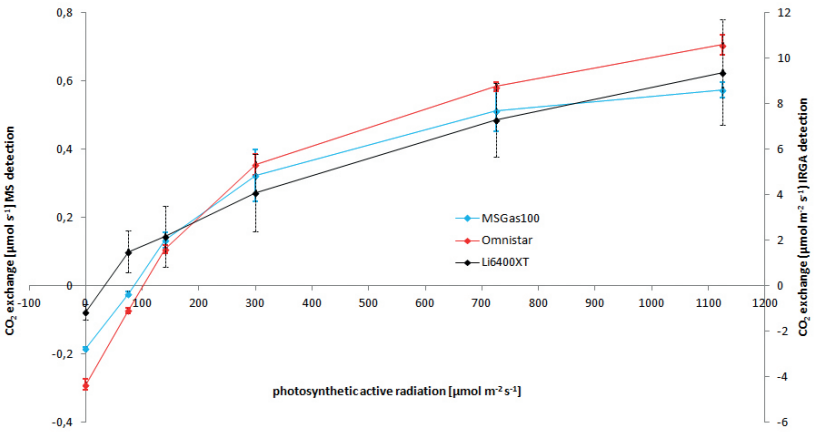

Figure 3 / a) Left y-axis: light curves of whole tomato plant determined by MS GAS-10 and Omnistar (blue and red line) b) Right y-axis: light curve of tomato leaf sample measured by Li6400XT (black line)