

Flash photolysis system

Easy measurement of the transient absorption spectrum and time-resolved fluorescence spectrum in the range of nanoseconds to milliseconds!

Examination of the formation and decay process of the reactive intermediate in the photoreaction.

- Time resolution of 10 ns
- Measurements with the smallest optical density (OD) of 0.01
- Simultaneous spectrum measurements from 260 nm to 800 nm (Measurements not affected by secondary light, etc.)
- Measurement time range from nanoseconds to milliseconds
- Compatible with 90° excitation / oblique incidence excitation



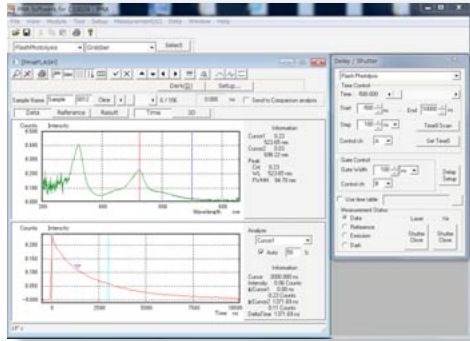


The flash photolysis system can perform transient absorption measurements within the short nanosecond range. The absorption spectrum of the formation and decay process of intermediaries in photoreactions such as photodissociation, photoisomerization reaction, etc can be observed. Due to the newly developed software added with the adoption of the optics, transient absorption spectrum measurements in the nanosecond range have been made easier.

Functions

The light from a high power xenon lamp is utilized for the probe light and a nanosecond Q-SW YAG laser is utilized for the pump light in the flash photolysis system. The light is measured using the PMA-12 Photonic multichannel analyzer C10029-01 equipped with a gate function by switching the probe light shutter and the pump light shutter with the exclusive software introduced with the flash photolysis optics.

Transient absorption measurements can be performed by executing each spectrum operation according to nonluminescent and luminescent samples.



Measurement functions

- Data measurements : Measurement of white light with both the pump light shutter and the probe light shutter open
- Monitor measurements : Measurement of white light with only the probe light shutter open
- Emission measurements : Measurement of fluorescence with only the pump light shutter open
- Dark measurements : Measurement of dark current with both the pump light shutter and the probe light shutter closed

Control functions

- Measurement conditions : Gate width, delay time, step time, accumulated number, I.I. (image intensifier) gain, and trigger mode

Analysis functions

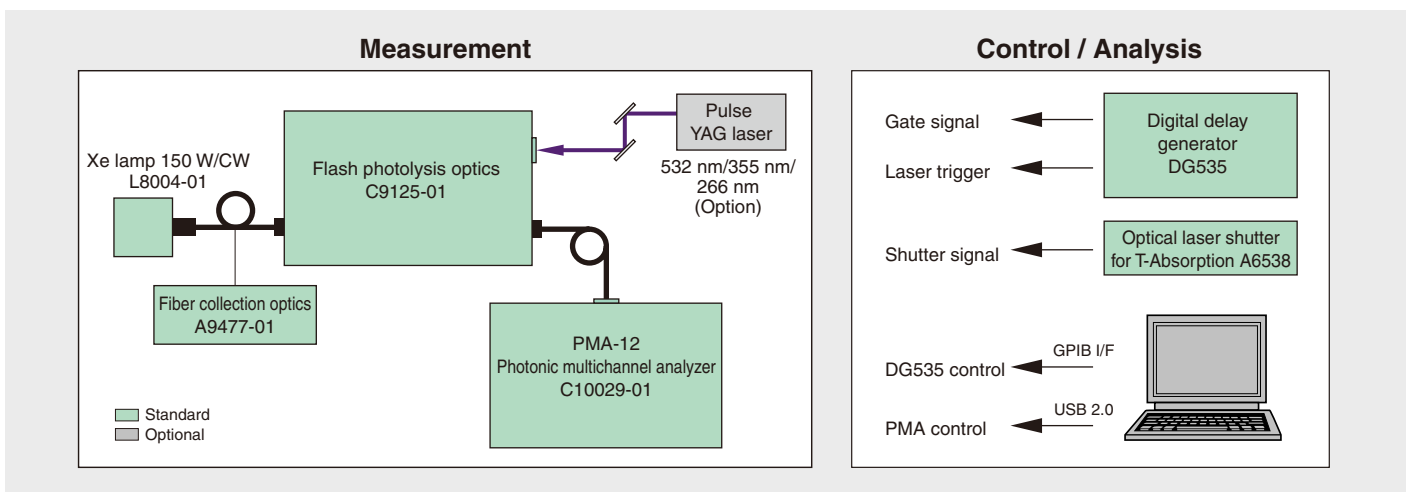
- Transient absorption measurement
 - For nonluminescent samples
Absorption 1 = $-\text{Log}_{10} [(Data-Dark)/(Monitor-Dark)]$
 - For luminescent samples
Absorption 2 = $-\text{Log}_{10} [(Data-Emission)/(Monitor-Dark)]$
- Time-resolved fluorescence measurements

Performance

Temporal resolution	10 ns
Measurement Δ OD value (during integration)	0.01 or less*
Spectral sensitivity	260 nm to 800 nm
Wavelength resolution	Less than 3 nm

* This value is defined as standard deviation of Δ OD measured under the 100 times integration.

System configuration

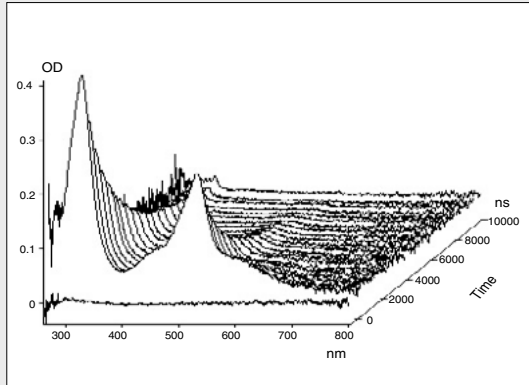


Measurement example

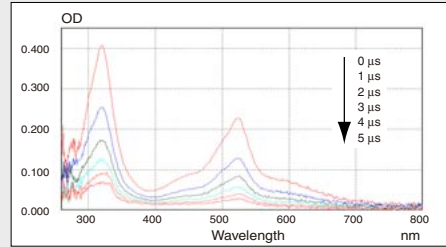
● Transient absorption measurement of benzophenone in a deaerated acetonitrile solution by N₂ gas

■ Measurement condition

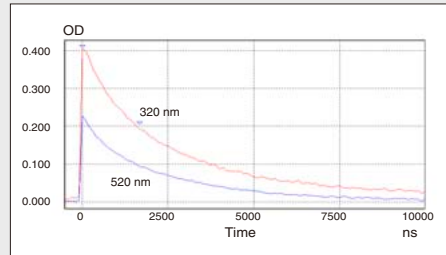
Benzophenone in acetonitrile solution
Excitation 266 nm 4 mJ



▲ Three-dimensional display (-0.5 μs to 10 μs, 0.5 μs step)



▲ Time resolved spectra



▲ Decay profiles

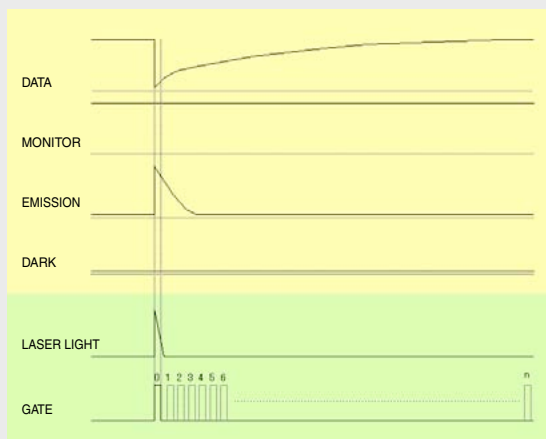
Operation principle

Time-resolved measurements are performed using a photonic multichannel analyzer equipped with a gate function.

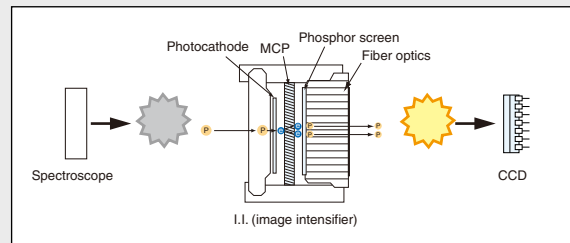


The PMA-12 Photonic multichannel analyzer C10029-01 includes a gate function with an image intensifier. The gate function is used to perform the time-resolved measurements.

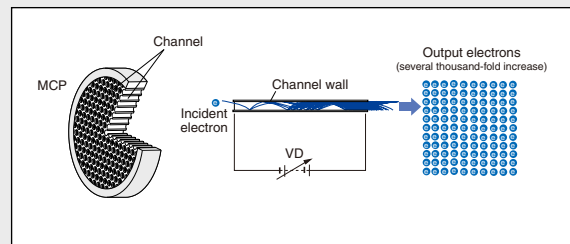
As shown below, the data, monitor, emission, and dark measurements are performed as the gate timing is delayed for the timing of the laser light. Since the PMA-12 Photonic multichannel analyzer 10029-01 enables to work with the smallest gate time of 10 ns, time-resolved spectral measurements can be performed in an extremely short time. In addition, the image intensifier consists of a microchannel plate (MCP) with a built-in secondary electron amplifier, and the images achieved in an extremely short time can be measured with high sensitivity in order to achieve a high gain of 1000 times or more.



● Image intensifier structure

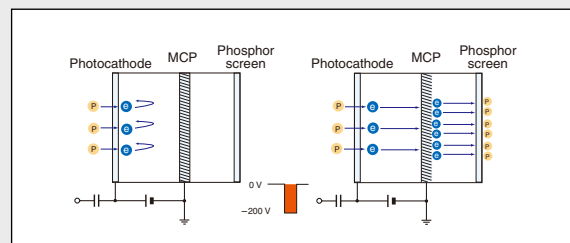


● Amplifier: Microchannel plate (MCP)



The image is amplified by the built-in MCP in the I.I. (image intensifier). Each narrow channel in the honeycomb shown above becomes a secondary electron multiplier. One electron increases to thousands of electrons as it passes through these channels.

● Gate operation



The gate operation is performed by changing the electric potential of the photocathode and the MCP-in. The electric potential of the MCP-in is fixed and the gate is operated at high speed by impressing a negative high-speed pulse on the photocathode. The width of this high-speed pulse becomes the gate time.

Specifications

● PMA-12 Photonic multichannel analyzer C10029-01

Ultra-high sensitivity and high-speed gate measurements achieved by coupling an image intensifier with a BT-CCD.



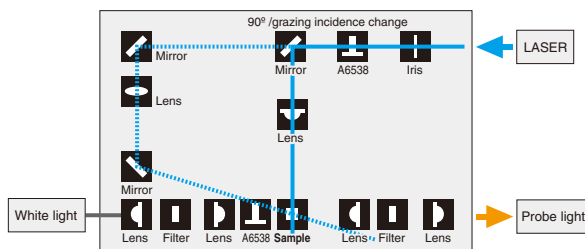
Photodetector	I.I. + BT-CCD linear image sensor
Wavelength measurement range	200 nm to 860 nm
Wavelength resolution (FWHM)	< 3 nm
Gate time	≥ 10 ns
Gate repetition	≤ 200 kHz
Effective number of channels	900 ch.
Component cooling temperature (CCD)	-15 °C
AD resolution	16 bit
Spectroscope	Czerny-Turner type
Spectroscope F value	4
Interface	USB 2.0

● Flash photolysis optics C9125-01

Measurements can be performed in the 260 to 800 nm wavelength range. The excitation uses both 90° and grazing incidence excitation and the excitation can be changed easily as needed.



Wavelength measurement range	260 nm to 800 nm
Laser mirrors	Dielectric multilayer mirrors 532 nm/355 nm/266 nm
Excitation angles	90° /oblique incidence
Sample holders	10 mm cell/2 mm cell (only oblique incidence can be used with 2 mm cells)
Option	Stirrer : a function to agitate the sample



● Optical laser shutter for T-Absorption A6538

A6538 includes 2 pieces of shutter heads and 1 unit of shutter controller. The shutter heads are used for pump and probe light, respectively.

Shutter type	Solenoid mechanism
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● Digital delay generator DG535

The DG535 is a versatile delay generator used to match the timing of the C10029-01 and the pulse laser.



Number of output channels	4 ch. (A, B, C, and D output terminals)
Output levels	TTL, ECL, NIM, and VAR 50 Ω/HIGH
Delay setting range	0 ps to 999.9 s
Minimum delay step	5 ps
Internal delay time	85 ns
Repetition frequency	Single to 1 MHz
Jitter	Approx. 100 ps
Interface	GPIB

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● Data analyzer Laptop type C10471-01

The data analyzer controls each function and performs data collection and analysis.



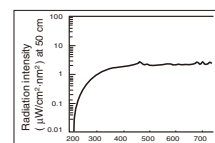
OS	Windows 7 (32bit)
Memory	1.8 GB or more
Hard disk	20 GB or more
Interface	USB 2.0 and GPIB
Data collection conditions	Gate width, delay time, step time, accumulated number, CCD exposure time, I.I. (image intensifier) gain, and trigger mode
Measurement functions	Data, monitor, emission, and dark
Analysis functions	Transient absorption spectrum and time-resolved fluorescence spectrum
Display functions	Spectral display, decay profile display, and 3D display
Corrections	Wavelength axis, sensitivity unevenness, and dark current corrections
Storage functions	Binary and text format

● USB-GPIB-HS

The interface that enables controls digital delay generator DG535 with a computer.

● Xe lamp 150 W/CW L8004-01

The Xe lamp 150 W/CW is a highly stable white light source with no shaking or movement at the point of arc radiation.



Radiation wavelength	185 nm to 2000 nm
Radiation intensity	250 nm : 0.52 (μW/cm ² · nm ⁻¹) at 50 cm 500 nm : 2.00 (μW/cm ² · nm ⁻¹) at 50 cm
Power consumption	150 W
Window material	Fused quartz
Light output stability	Drift : ± 0.5 %/h (typ.) Shake : 1.0 % p-p (min.)

● Fiber collection optics A9477-01

A9477-01 is an optics which introduce probe light from a lamp house of L8004-01 into C9125.

● Nd:YAG laser (option)

The YAG laser is an excitation light source for transient absorption measurements. The flash photolysis system can be configured with the lasers from either company listed below.



■ Recommended lasers

Continuum Company : Minilite-II
Surelite-II-10
Spectra-Physics Inc. : INDI-40



Laser	Minilite-II	Surelite-II-10	INDI-40
Repetition	1-15 Hz	10 Hz	10 Hz
Pulse width	3-7 ns	4-7 ns	6-9 ns
Output	1064 nm : 50 mJ 532 nm : 25 mJ 355 nm : 8 mJ 266 nm : 4 mJ	450 mJ 200 mJ 60 mJ 50 mJ	450 mJ 200 mJ 100 mJ 55 mJ

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