

HARPIA | TA

Ultrafast Transient Absorption Spectrometer

FEATURES

- Excellent performance at a high repetition rate
- Measurement range from UV to MIR
- Market-leading sensitivity
- Modules for time-resolved, and multi-pulse experiments
- High-level automation in a compact footprint

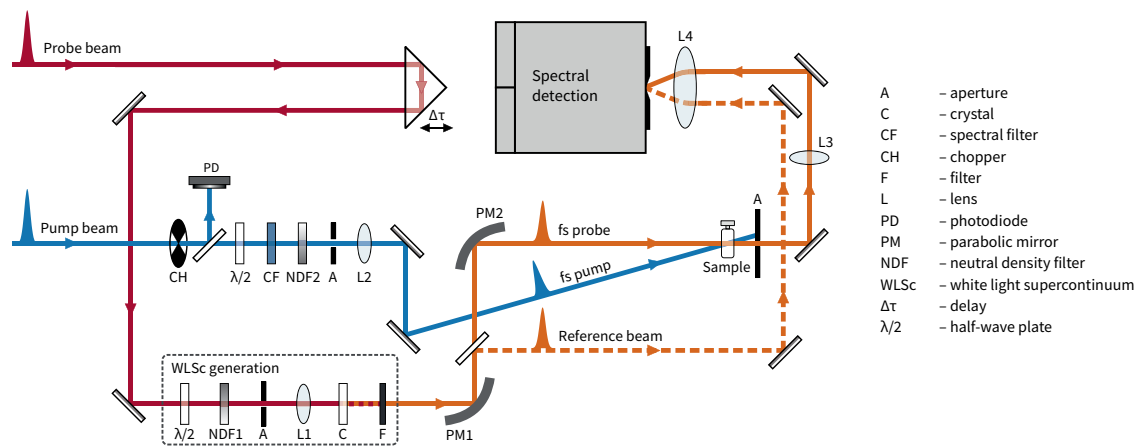


Layout example

The HARPIA-TA ultrafast transient absorption spectrometer provides pump-probe measurement functionality in a HARPIA system. Several probe light configurations and detection options are available: from a photodiode for single-wavelength detection to white-light supercontinuum probing combined with spectrally-resolved broadband detection. HARPIA-TA features extensive options providing pump beam position tracking and alignment, pump

polarization control, supercontinuum generator switching, sample positioning, and switching between transient absorption and transient reflection measurements. Broadband probe options cover from UV to MIR. The probe delay stage is configurable up to 8 ns.

HARPIA-TA is compatible with cryostats, peristaltic pumps, and other accessories. The capabilities of the spectrometer can be further extended using extension modules.



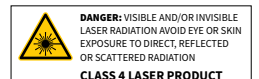
HARPIA-TA optical layout for pump-probe experiments

SPECIFICATIONS

Configuration	UV-VIS	VIS	VIS-NIR	UV-VIS-NIR	MIR
Measurement range ¹⁾	350 – 1100 nm	460 – 1100 nm	460 – 1600 nm	350 – 1600 nm	2000 – 13000 nm
Pump range	240 – 1100 nm				240 – 700 nm
Delay range (resolution)	8 ns (8.3 fs)				4 ns (4.2 fs)
Temporal resolution	\leq laser pulse duration or better				
Laser repetition rate	1 – 200 kHz ²⁾				
Maximum data acquisition rate	3 kHz				Laser repetition rate

¹⁾ For laser pulse duration of up to 400 fs.

²⁾ Higher repetition rates available; contact sales@lightcon.com for details.



MODULES AND ACCESSORIES

HARPIA | TF

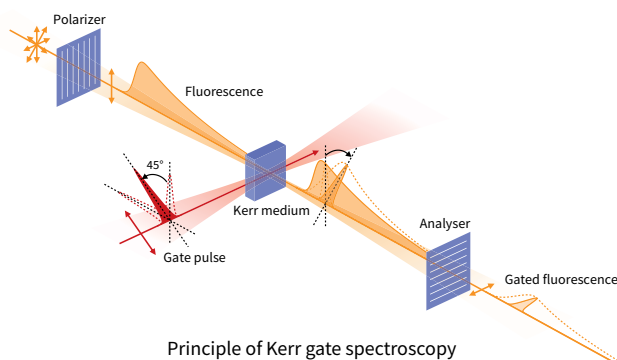
Time-Resolved Fluorescence Module

Time-resolved fluorescence spectroscopy carries information on the molecular processes in the excited states. HARPIA-TF combines different measurement modes, thus allowing the observation of fluorescence dynamics at different time scales.

MODES

- Kerr gate** NEW
 Easy to use for fs fluorescence measurements. Simpler alignment and maintenance. The entire spectrum is measured at once.
- Fluorescence upconversion (FU)**
 Better temporal resolution for measuring fast fluorescence events.
- Time-Correlated single-photon counting (TCSPC)**
 Fluorescence lifetime measurements are extendible to measure phosphorescence signals.

Using a high-repetition-rate PHAROS or CARBIDE laser, the fluorescence dynamics can be measured while exciting the samples with pulse energies down to several nanojoules.



SPECIFICATIONS

Module	HARPIA-TF NEW		
Mode	Kerr gate	Fluorescence upconversion	TCSPC
Spectral range	250 – 1100 nm	330 – 820 nm	220 – 820 nm ¹⁾
Pump range	240 – 1100 nm		
Temporal resolution	400 – 500 fs	≤ laser pulse duration or better	< 180 ps ²⁾
Max measurement range	8 ns		∞ ³⁾
Delay resolution	8.3 fs		n/a
Gate beam requirements	20 – 25 μJ		n/a
Compatible with	TCSPC		Kerr gate or fluorescence upconversion

¹⁾ Spectral range is extendable to NIR; contact sales@lightcon.com for details.

²⁾ High-speed detector available (< 50 ps); contact sales@lightcon.com for details.

³⁾ Maximum measurement range depends on the phosphorescence signal.



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LASER RADIATION AVOID EYE OR SKIN
EXPOSURE TO DIRECT, REFLECTED
OR SCATTERED RADIATION
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HARPIA | TA-FP

Flash Photolysis – Nanosecond TA Module

The flash photolysis experiment is designed to measure the long-lived states of molecular systems.

The principle of flash photolysis is analogous to the femtosecond transient absorption (TA) experiment but with a delay in a nanosecond–millisecond range.

SPECIFICATIONS

Module	HARPIA-TA-FP	HARPIA-TA-FP-UV
Measurement range ¹⁾	450 – 1100 nm	350 – 1100 nm
Delay range	up to 8 ms	up to 500 μs
Delay resolution	100 ps	
Temporal resolution	2 ns	1 ns
Maximum data acquisition rate	3 kHz	

¹⁾ Maximum wavelength depends on HARPIA-TA and is either 1100 nm or 1600 nm.

HARPIA | TB

Third Beam Delivery Module

When standard spectroscopy tools are not enough to unravel the intricate ultrafast dynamics of photoactive systems, multi-pulse time-resolved spectroscopic techniques can be utilized to yield additional insight.

It allows an additional temporally-delayed laser pulse (up to 4 ns) to be introduced before or during the pump-probe interaction to perturb the ongoing photodynamics.

SPECIFICATIONS

Module	HARPIA-TB	
Mode	Pump for multi-pulse experiments	NIR probe
Wavelength range	240 – 700 nm / 450 – 1100 nm	1600 – 2600 nm
Delay range (resolution)	4 ns (4.2 fs)	

MODES

Femtosecond stimulated Raman scattering (FSRS)

Delivering frequency-narrowed ps pulses allows to perform FSRS measurements. It is a relatively recent yet moderately widespread time-resolved spectroscopy technique for observing changes in the vibrational structure of optically excited molecular systems.

Multi-pulse time-resolved transient absorption and reflection

The pump-pump-probe (PDP), Pump-repump-probe (PrPP) and Pre-pump-pump-probe (pPPP) techniques is a way to manipulate the reactions and access new regions of the higher excited states.

HARPIA | MM

Microscopy Module

HARPIA-MM is a microscopy module add-on to the HARPIA-TA spectrometer, which enables spatially resolved pump-probe measurements. It allows the acquisition of time-resolved spectra at a fixed position, difference absorption images at a fixed probe delay, and other types of data.

The microscopy module features a motorized XYZ sample stage, broadband, and monochromatic probe options, as well as transmission and reflection modes, and brightfield mode to observe the sample and to determine the pump-probe spot location.

SPECIFICATIONS

Module	HARPIA-MM	
Spatial resolution ¹⁾	monochromatic	polychromatic
	< 2 μ m	< 10 μ m
Full spectral range	460 – 1100 nm	
Pump range	240 – 700 nm	
Temporal resolution	500 fs	
Maximum working distance ²⁾	13 mm	
Sample motion range	13 \times 13 \times 13 mm	

¹⁾ White light generation has axial color at focus and wavelength-dependent mode size and NA. Focused white light will exhibit focus shift and spot size variation depending on the chosen spectral range. Polychromatic spot size is given at full spectral range, monochromatic is at 500 nm with a 10 nm bandwidth.

²⁾ Depends on the objective used.

MODES

Switching between bulk and microscopic pump-probe modes is implemented using self-contained modules, allowing experiment reconfiguration without disturbing the sample.

Microscopy module



Bulk module



OPTIONS



Cryostat Mounting

HARPIA-TA supports cryostats that can be mounted externally or internally.



Sample Stirrer

Liquid samples are mixed up to avoid overexposure and ensure fresh sample.



Motorized Pump Mirror

Used to automatically optimize pump and probe overlap.



External Beam Steering

To lock the optical beam paths for OPA wavelengths (350 – 1100 nm).



Beam Profiler

For checking beam shape/size at any position before/after measurement inside HARPIA

SOFTWARE

HARPIA Service App

Control and data acquisition software

A single software solution for all measurement modes, featuring:

- User-friendly interface
- Measurement presets
- Measurement noise suppression
- Diagnostics and data export
- Continuous support and updates
- API for remote experiment control using third-party software (LabVIEW, Python, MATLAB)

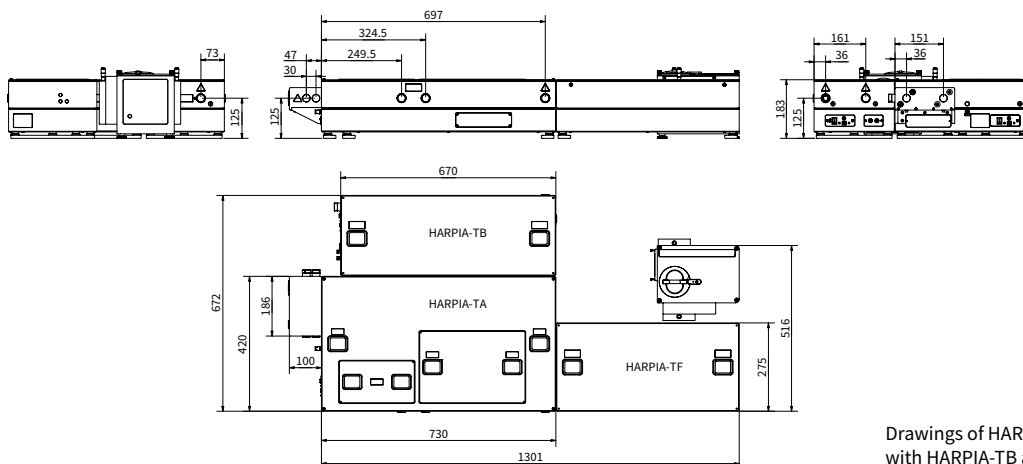
CarpetView

Data analysis software

An ultrafast spectroscopy data analysis software, featuring:

- Advanced data wrangling: slicing, merging, cropping, smoothing, fitting, etc.
- Advanced global and target analysis
- Probe spectral chirp correction, calibration and deconvolution
- Support for 3D data sets (2D electronic spectroscopy, fluorescence lifetime imaging)
- Publication-ready figure preparation and data export

DRAWINGS



Drawings of HARPIA system with HARPIA-TB and HARPIA-TF modules

HARPIA | TG

Transient Grating Spectrometer



NEW

FEATURES

- Carrier diffusion coefficient in a matter of minutes!
- Non-invasive measurement technique
- Fully automated and computer controlled
- Continuous setting of grating period
- Sensitivity down to $\mu\text{J}/\text{cm}^2$ excitation level
- Advanced measurement and analysis software
- Photoluminescence (PL) measurement option



HARPIA-TG is a transient grating spectrometer for the measurement of carrier diffusion and lifetime. Measurements are based on the laser-induced transient grating (LITG) technique. This method enables simultaneous observation of non-equilibrium carrier recombination and diffusion by all-optical means.

HARPIA-TG allows the characterization of electrically non-conductive or non-fluorescent samples. It is suitable for semiconductors materials and derivatives, e.g., silicon carbide (SiC), gallium nitride (GaN), perovskites, organic and inorganic solar cells, quantum dots, and even complex nanostructures such as quantum wells.

SPECIFICATIONS

Model	HARPIA-TG
Grating recording wavelength ¹⁾	340 – 560 nm
Probe wavelength ²⁾	1030 nm
Grating period ³⁾	1.15 – 15 μm
Pulse duration	< 290 fs
Delay range	Up to 8 ns

MEASUREMENT RANGES

Diffusion coefficient	0.1 – 50 cm^2/s
Carrier lifetime	1 ps – 80 ns

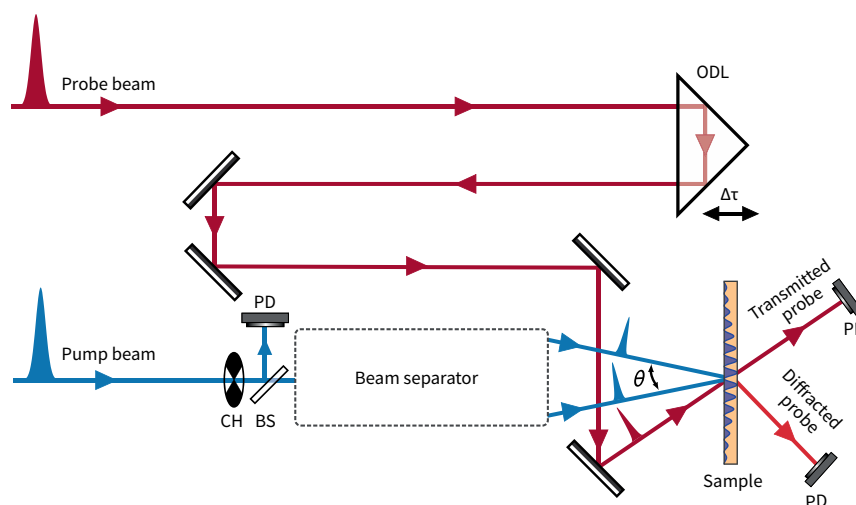
¹⁾ Extendable to long-wave VIS/NIR. Contact sales@lightcon.com for details.

²⁾ SH (515 nm) or OPA-based probe is available upon request. Contact sales@lightcon.com for details.

³⁾ Depends on the excitation wavelength.



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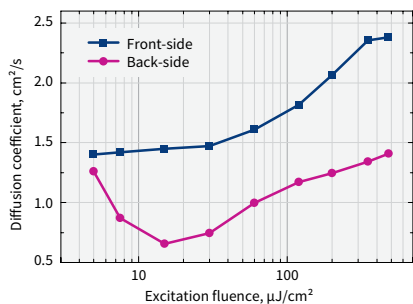
Principal scheme of HARPIA-TG

PERFORMANCE

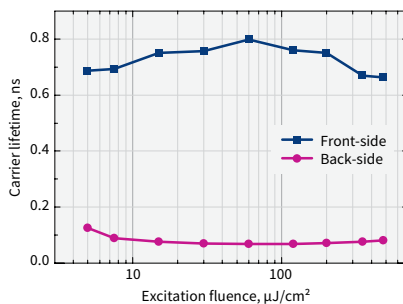
GaN

The graphs below indicate the carrier diffusion coefficient, diffusion length, and lifetime of GaN at the back and at the front of the layer as a function of fluence. The thicker the GaN, the better the quality of the grown layer due to better coalescence. It is evidenced by the lower diffusivity and shorter lifetimes

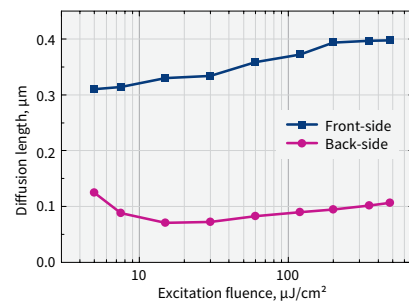
that indicate poor structural quality and higher defect density at the interface between the sapphire substrate and GaN. Measurements were performed using HARPIA-TG combined with CARBIDE-CB5 laser and I-OPA. Measurement conditions: 60 kHz, 355 nm pump wavelength, 1030 nm probe wavelength.



Diffusion coefficient of GaN as a function of fluence



Carrier lifetime of GaN as a function of fluence

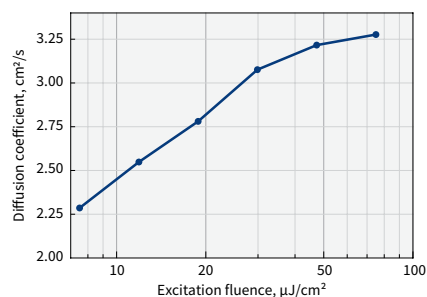


Diffusion length of GaN as a function of fluence

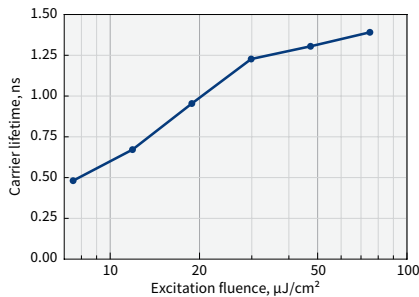
SiC

Silicon carbide (SiC) is a compound semiconductor with unique properties, valued for its high thermal conductivity, wide bandgap, and excellent electrical performance. In SiC devices, where high-frequency, high-temperature,

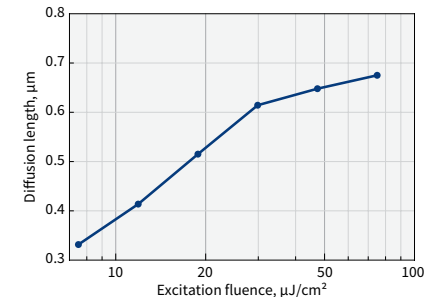
and high-voltage operation is common, managing carrier diffusion is particularly critical to ensure efficient and reliable device performance, making it a key consideration in SiC semiconductor technology.



Diffusion coefficient of SiC as a function of fluence

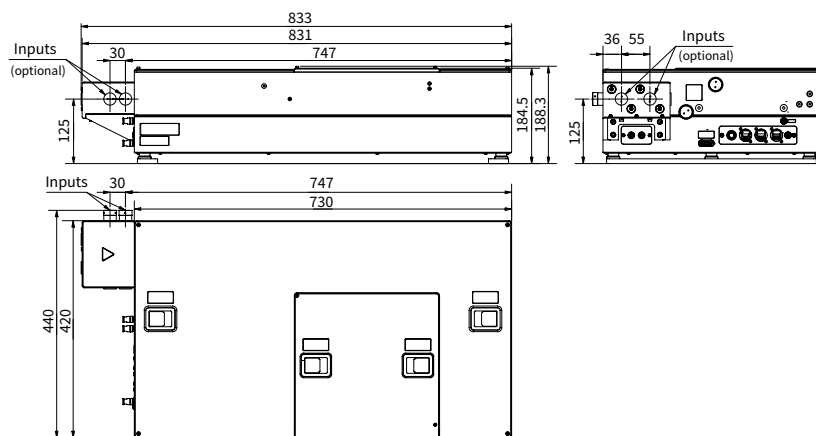


Carrier lifetime of SiC as a function of fluence



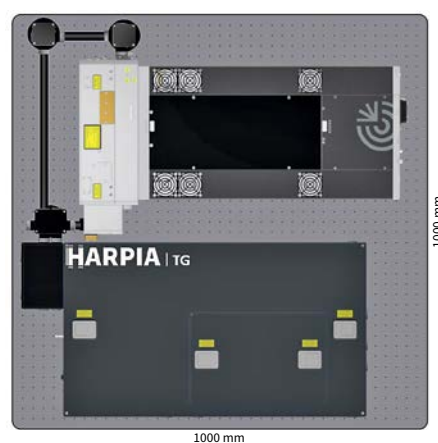
Diffusion length of SiC as a function of fluence

DRAWINGS



Drawing of HARPIA-TG

RECOMMENDED LAYOUT



Recommended layout with CARBIDE-CB5 and I-OPA