



TRlton

LayTec's TRlton is a reflectance based integrated metrology system for in-situ monitoring equipped with its own GUI for operating the measurement process of plasma etch depth in real time. It is especially designed to obtain fully automated End Point Detection (EPD) for R&D and industrial applications. It is suitable for a wide range of semiconductor-based materials, processes, and products. Applications include but are not limited to power electronics and RF, transmitters and detectors for fiber communications, laser system for cutting/welding.

Features

End Point Detection (EPD)

- Automatic and reproducible end point detection for plasma etching of GaN HEMT, GaN based lasers, InP-based lasers, photodiodes and quantum cascade detectors, GaAs-based high power laser diodes
- Compatible with etching of both p-GaN-type and recess-type gate structures
- Compatible with dry etch of wide range of doped and undoped InP alloys (binary, ternary, quaternary), GaN alloys as well as GaAs alloys
- Compatible with Oxford Instrument Plasma Technology, SENTECH, SAMCO etchers (compatibility with further manufacturers will be evaluated per request)
- Measures in real time residual thickness in the range 0nm – 20nm
- Maximum error in thickness 0.5nm
- Required test pad area 0.5 x 0.5mm

Measurable parameters

- Reflectance: Noise typically better than $\pm 0.04 \%$
- Etch rate: 0.1-10 nm/sec
- Reproducibility End Point Detection: 0.5 to 1.5 nm

Benefits

Variants

Variant #	Suitable for material system	Led wavelength (nm)			Spot size (µm)	Suitable for etch process
		Led1	Led2	Led3		
1	GaN	340	365	405	300	Atomic Layer Etch
2	InP, GaN & InP	340	670 (or 405 nm)	365 (or 670 nm)	300	Induced Coupled Plasma
3	GaAs	488	633	670	150, 300	Induced Coupled Plasma

Description of the parts

Light sources

Light source	High brightness LED module
Standard wavelengths and bandwidth (nm)	340 ± 1, 365 ± 1, 405 ± 1, 488 ± 1, 633 ± 1.5, 670 ± 1, 950 ± 5, others on request
Life-time according to manufacturer (h)	>10 000 for UV Leds, > 20 000 for other Leds

Camera

Camera

- CMOS camera with pulsed blue (dependent on application) LED illumination
- Resolution down to <10 µm
- Maximum field of view: 50x40 mm

Scan images based on the reflectance level colour

- For all 3 wavelengths Led1, Led2 and Led3

Electrical interface

- RJ45 Ethernet: permanent connection between measurement tool and LayTec metrology computer or temporary connection to service notebook
- RJ45 Ethernet: permanent connection between camera and LayTec metrology computer or temporary connection to service notebook
- M10 4-pin A-coded connector: connection to 24V power supply
- 10pin PhoenixContact connector:
 - "interlock" from system to base unit (potential free input)
 - "etch start" trigger from system to base unit (potential free input)
 - "etch stop" trigger from base unit to system (potential free output)

Positioning

- Motorized X-Y translation stage with up to 19mm travel each direction and minimal step width of 10µm
- Supports 2D-scanning of sample with all installed measurement wavelengths

Variant performance

Variant 1 (GaN)

Parameter	Led #	Standard wavelength (nm)	Raw Led# ¹	Normalized Reflectance	Background Led# ²	Normalized Noise to Raw Led	SNR led# ³	Log SNR (dB)
	Led1	340	19887	2.6	1290	0.2	8422	78.5
	Led2	365	22065	2.9	1299	0.2	11566	81.3
	Led3	405	7625	1.0	1289	0.2	5469	74.8

Variant 2 (GaN & InP)

Parameter	Led #	Standard wavelength (nm)	Raw Led# ¹	Normalized Reflectance	Background Led# ²	Normalized Noise to Raw Led	SNR led# ³	Log SNR (dB)
	Led1	340	6523	1.0	1314	0.2	1269	62.1
	Led2	670	20217	3.1	1352	0.2	5198	74.3
	Led3	405	21112	3.2	1289	0.2	5469	74.8

Variant 3 (GaAs)

Parameter	Led #	Standard wavelength (nm)	Raw Led# ¹	Normalized Reflectance	Background Led# ²	Normalized Noise to Raw Led	SNR led# ³	Log SNR (dB)
	Led1	488	17602	1.0	1304	0.1	11863	81.5
	Led2	633	23069	1.3	1313	0.1	11537	81.2
	Led3	950	19305	1.1	1297	0.1	13625	82.7

Formulas

Normalized Reflectance = Raw Led_i/MIN(Raw Led₁:Raw Led₃)*
 Normalized Noise = Background Led_i/MIN(Raw Led₁:Raw Led₃)
 Log SNR, dB = 20*LOG(SNR led_i)
 *These measurements need to be performed on a standard substrate (e.g.: Si wafer)

¹ Typical Average Reflectance Si (+/-25 counts), lin.scale;

² Typical Average Noise (counts), lin. Scale;

³ Typical Average [Refl. Si] over Stdev [Refl. Si]

Software

Operating SW: EtchNet

- Save etch transient (time varying reflectance), etch transient replay, at multiple wavelengths; no spectral data (Int(t) for each wavelength); recipe editor to design optimized algorithms suitable to End Point Detection requirements (available by end of Q2-2024)
- GUI: display of data (from data base as well as live data), data base access fitting method, tool calibration
- Algorithms for End Point Detection: Algorithms available with adjustable parameters in Firmware
Example: Oscillation counting; Comparison to simulation/modelling/reference or golden run; Comparison with characteristic features including but not limited to: change in etch rate period, change in reflectance amplitude, in shape of reflectance, or combination of all 3 wavelengths

Auxiliary programs: SimulyzR

- Simulations of reflectance; data base access for dispersion (encrypted)
- Extraction of optical constants of etched materials/alloys. Example: binary, ternary, quaternary InP-based alloys at 3 TRItton wavelengths

Operating conditions

- Power supply 24V DC
- Typical current consumption < 1 A
- Maximum power consumption 24 W
- Weight approx. 3.8 kg
- Dimensions approx. 350 x 350 x 350 mm
- Operation temperature 20°C – 24°C
- Storage temperature 15°C – 35°C
- Maximum operation humidity 50 %
- Maximum storage humidity 50 %

Specifications are subject to further technical development and may differ from those given in the data sheet. In certain cases, performance may be limited by reactor type and/or growth conditions. Please consult our technical sales team to see how LayTec metrology can best serve your specific application.

For further information please contact:

LayTec AG

Seesener Str. 10-13
10709 Berlin, Germany

Tel.: +49 (0)30 89 00 55-0
Fax: +49 (0)30 89 00 55-180
Email: info@laytec.de
Web: laytec.de



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