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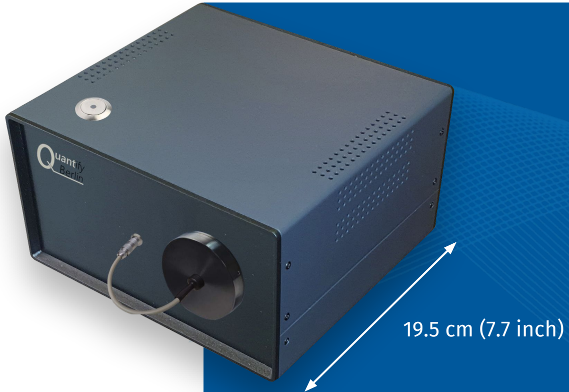
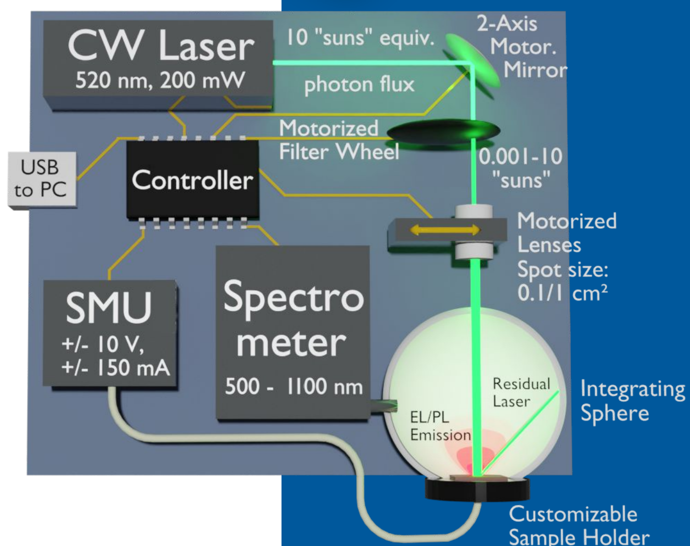
LumY Pro

The Absolute Luminescence Quantum Yield System

When developing opto-electronic devices, such as LEDs or solar cells, it is essential to improve their radiative efficiency. This requires precise techniques to determine the luminescence quantum yield. The LumY Pro is an easy-to-use, non-invasive and versatile system with unparalleled compactness to swiftly quantify absolute electro- and photoluminescence photon fluxes of thin film absorbers, layer stacks or complete devices under various operating conditions.

System & Layout





Swift quantification of **Absolute Photon Fluxes** from electro- and photoluminescence (**EL & PL**) of semiconductor thin films & devices

USB-“Plug & Play”: the included software records emission spectra & directly calculates **EL/PL Quantum Yield & Quasi-Fermi Level Splitting**

Small & Portable Layout allows flexible usage e.g. in gloveboxes

One-Click & High-Throughput Measurement

- Absolute number of photons from steady-state EL/PL spectra (500–1100 nm)
- Automated, continuously adjustable laser intensity from 0.001-10 “Suns”
- Current/voltage biasing and sensing via integrated source & measure unit (SMU)
- EL/PLQY sensitivity range: 1E-4 %

Software & Applications

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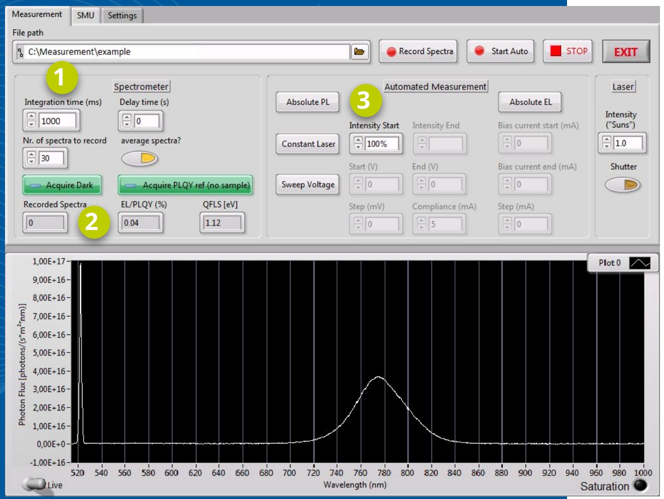
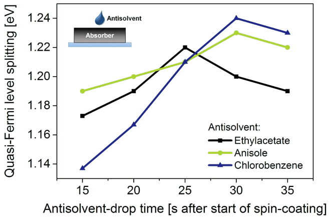


1 **Absolute photon flux measurement**
Records single or multiple EL/PL spectra for pre-set laser intensity, voltage & current bias

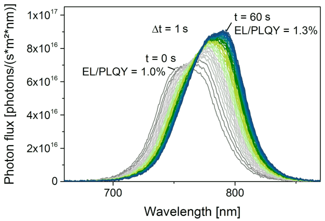
2 **Immediate calculation of EL/PLQY & QFLS**

3 **Automated measurement sweeps**
Varies laser intensity, bias voltage & current and determines absolute PL/EL spectra, EL/PLQY and QFLS at each operating point



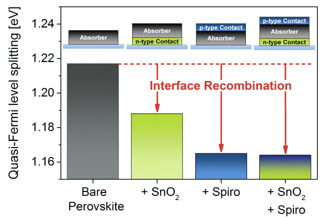
Quality Assessment

Quality assessment for rapid **Process Control** after each fabrication step or for **Accelerated Material and Process Parameter Screenings.**



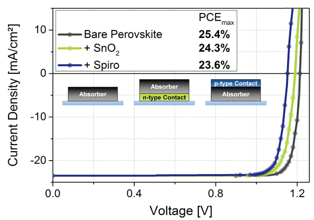
Transient Effects

Fast Acquisition resolves **Shifts in Emission Spectrum & Intensity** as well as **EL/PLQY and QFLS** on timescales from 10 ms to several hours.



Resolve Bulk & Interface Recombination

Quantifying Bulk and Interface Recombination Losses in semiconductor thin films, layer stacks or complete devices such as solar cells or LEDs. Examples in academic publications can be found in [1-6].



Efficiency Potentials & Loss Mechanisms

In-depth analysis of efficiency potentials and loss mechanisms in semiconductor thin films, layer stacks or complete devices, e.g. by determining **Ideality Factors and Pseudo-JV Curves from Intensity and/or Bias-Voltage Dependent EL/PLQY & QFLS**. Also see [7-9]

Technical Specifications & References

Technical Specifications

Current-voltage source and measure unit (SMU) max. ratings	+/-10 V, +/-150 mA
Max. sample dimensions (L x W, unrestricted height)	30 x 30 mm
Max. no. of contactable subcells on sample by integrated relais box	6 subcells
Photoexcitation intensity (continuously adjustable)	0.001 – 10 “Suns”
Photoexcitation wavelength	520 nm
Photoexcitation spot size (interchangeable)	0.1 cm^2 / 1 cm^2
Spectral detection range	500 - 1100 nm
Quantum yield sensitivity range	10-4 – 100%
Corresponding min. resolvable QFLS for 1.6 eV absorber band gap	1.0 eV
Spectrometer integration time	1 ms – 65 s
Dimensions (L x W x H)	220 x 195 x 120 mm
Weight	4.7 kg
Connectors	1x DC, 1x USB 3.0

References

References marked with ‡ indicate publications with contributions from members of our team.

Resolving bulk and interface recombination losses from absolute PL:

[1]‡ Unold et al., Advanced Characterization Techniques for Thin Film Solar Cells, Chapter 7: Photoluminescence Analysis of Thin-Film Solar Cells, Wiley, 2011, ISBN: 9783527410033
[2]‡ Al-Ashouri et al., Energy Environ. Sci., 2019, 12, 3356-3369
[3]‡ Kegelmann et al., ACS Appl. Mater. Interfaces, 2019, 11, 9, 9172-9181
[4]‡ Stolterfoht et al., Energy Environ. Sci., 2019, 12, 2778-2788
[5]‡ Liu et al., ACS Energy Lett., 2019, 4, 1, 110-117
[6]‡ Kirchartz et al., Adv. Energy Mater., 2020, Early View 1904134.

Ideality factor and pseudo-JV curves from light-intensity dependent absolute PL:

[7]‡ Caprioglio et al., Adv. Energy Mater., 2019, 9, 33, 110-117
[8]‡ Stolterfoht et al., Adv. Mater., 2020, DOI: 10.1002/adma.202000080
[9] Chris Dreessen et al., Journal of Luminescence, 2020, 222, 117106

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