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201803

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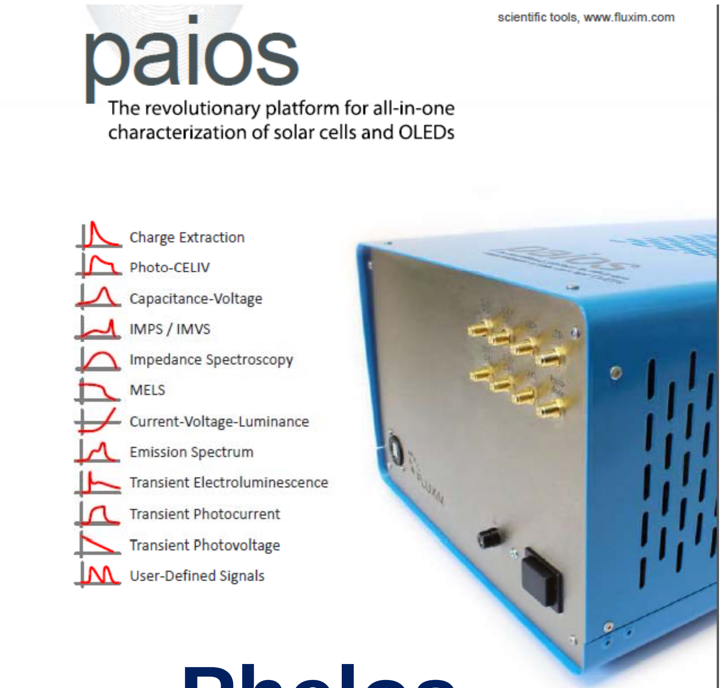
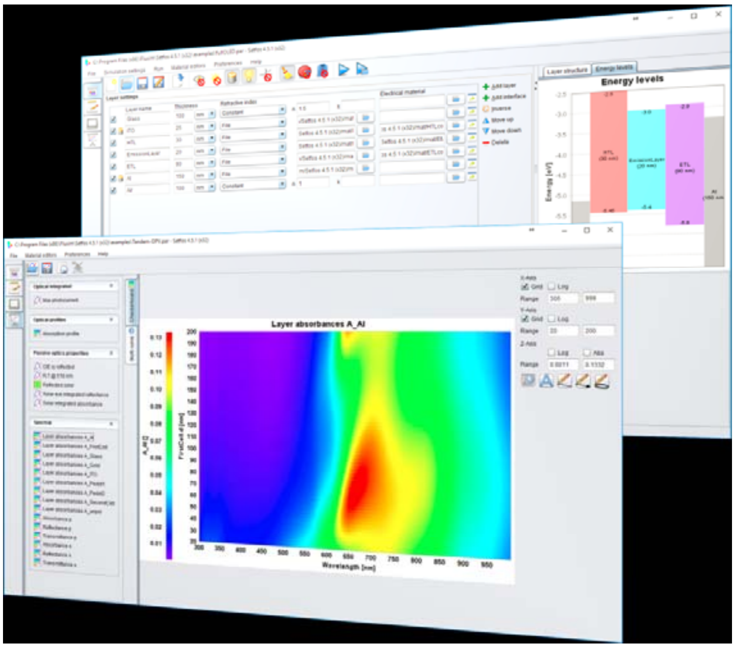
Paios 4.X

多功能有机光电器件量测系统，整合稳态，瞬态，以及交流阻抗多种量测技术，是OLED/OPV研究人员最佳的量测工具！



Setfos 4.X

世界上最先进的OLED/OPV模拟软件，被广泛的应用在全世界的面板制造商和研究单位并获得各界的认可！

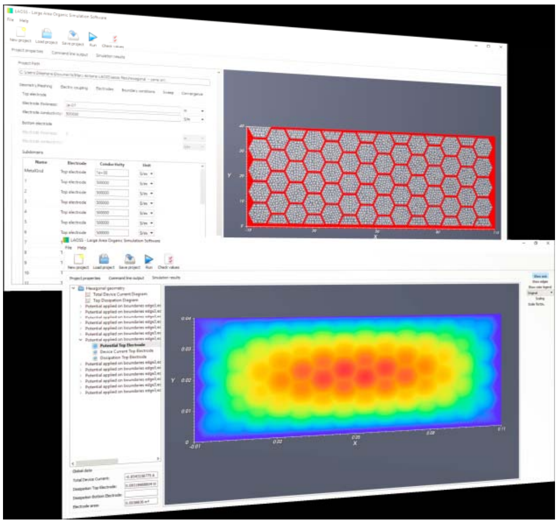


Phelos

OLED专用量测设备，可量测获得
1、不同角度下的发光光谱和颜色
2、OLED器件IVL特性, EQE, lm/W, Cd/A
3、结合Setfos软件提取有机材料分子方向性和分子分布情况
4、有机材料的pl

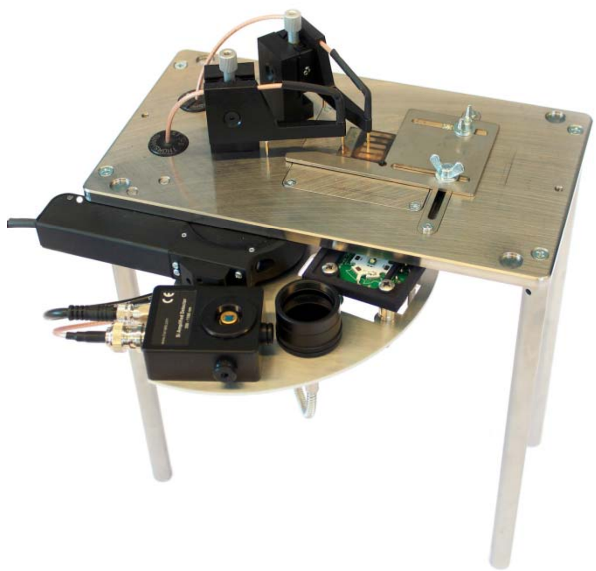
LAOSS

用于大面积OLED/OPV器件的模拟软件
1、模拟非理想电极在大面积器件中的对器件性能的影响，并且对电极的结构和设计进行优化
2、有考虑电热对器件的性能的影响
3、模拟OLED不同像素之间的串扰



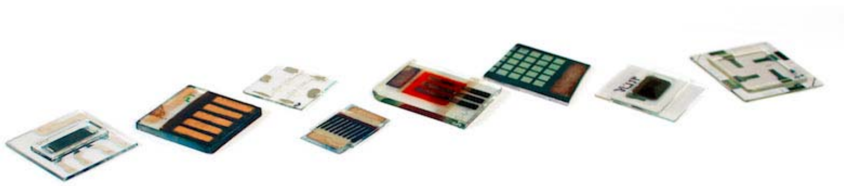
Paios 4.X

Paios自动量测台及各项功能



系统规格：
采样率：60MS/S　　时间解析度：16ns
测试电压：±10V（标准规格），±60V（选配）
测试频率：10mHz~10MHz　　最小可解析电流：<100pA
量测分辨率：12Bit　　量测时间：100ms

适用器件：
钙钛矿/有机/量子点等混合式太阳能电池
染料敏化电池
OLED，LEC，单载子器件，金氧半器件

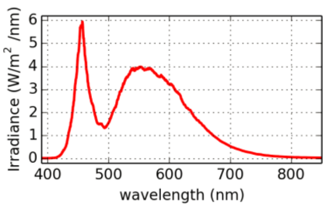


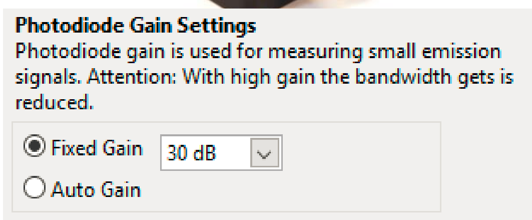
LED光源：
LED上升时间：100ns
LED光照面积：1.7cm²
LED驱动电流：100mA
LED颜色：白光

光探测器：
增益：0dB-70dB手动可调
探测面积：13mm²
探测光谱范围：350nm-1000nm
自动增益（选配）：通过软件控制

The automated measurement table **automatically switches** between measurement instruments and light-sources. The default configuration is equipped with:

- LED light source
- Photodetector
- Spectrometer
- Empty space for existing sun-simulator





For Solar Cell Research

A **sun-simulator can be placed below the** measurement table. When Paios moves away the instruments, the cell is illuminated by the sunsimulator and the power conversion efficiency is determined. Measure transient electroluminescence, the EL spectrum and all classical experiments with an LED. Everything automated. Everything with one click.

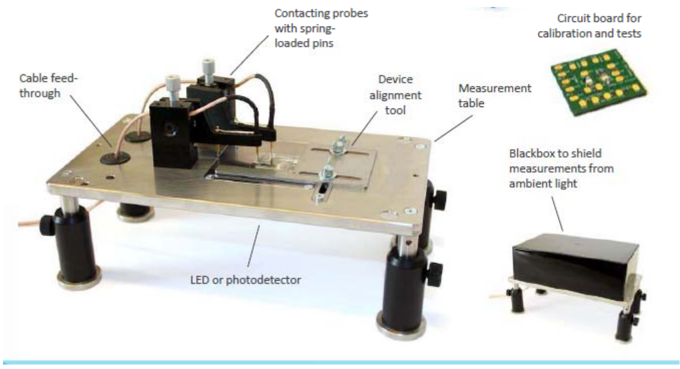
光谱仪（选配模块）：
光谱范围：360nm-1100nm　　积分时间：1ms-10min
可以获得OLED参数：luminance, radiance, EQE, lm/W, CRI, CIE coordinates

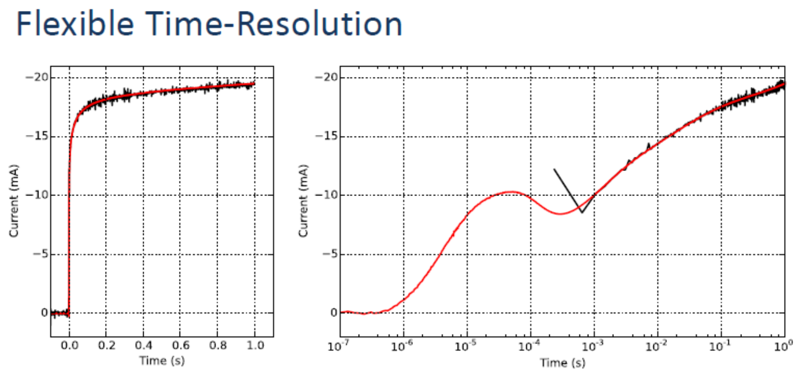
For OLED Research

Measure the OLED spectrum and transient electroluminescence without changing manually the measurement instrument. Using a blue or UV LED Paios can also measure photo-responses of OLEDs.

Paios 4.X

Paios软,硬件特殊功能

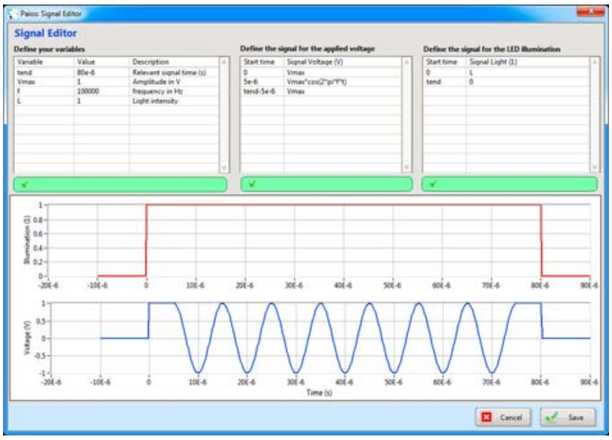


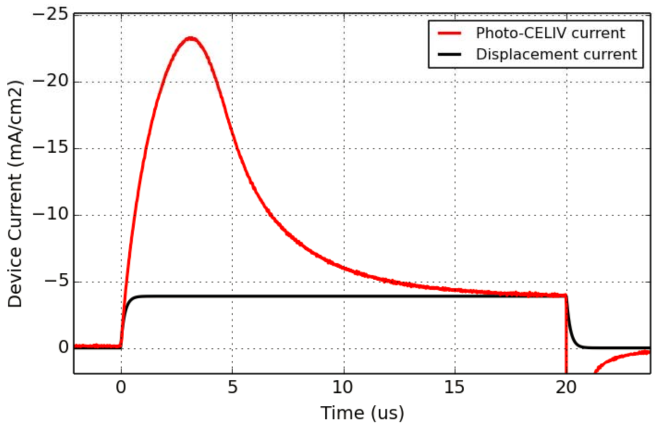


Transient photocurrent of a perovskite solar cell with linear time scale (left) and logarithmic time scale (right).

高集成度的硬件设计，测量台以及探测探针可以灵活控制便于用户测量不同大小的样品以及不同电极设计的样品

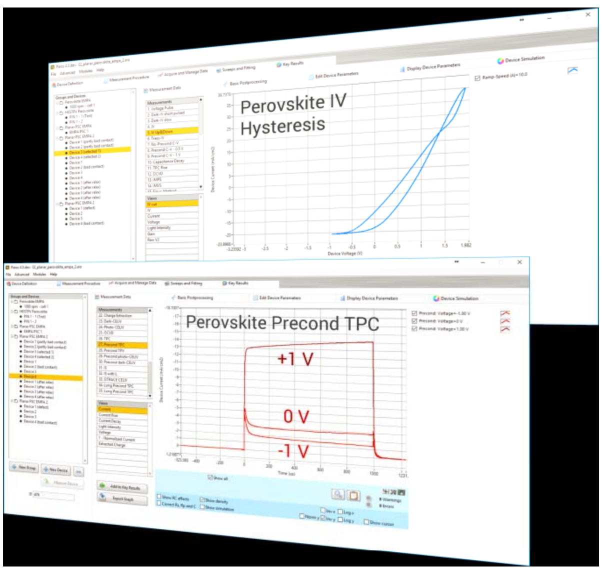
灵活的时间选择，用户可以利用**Paios**提供8个数量级时间跨度，测试钙钛矿电池TPC信号

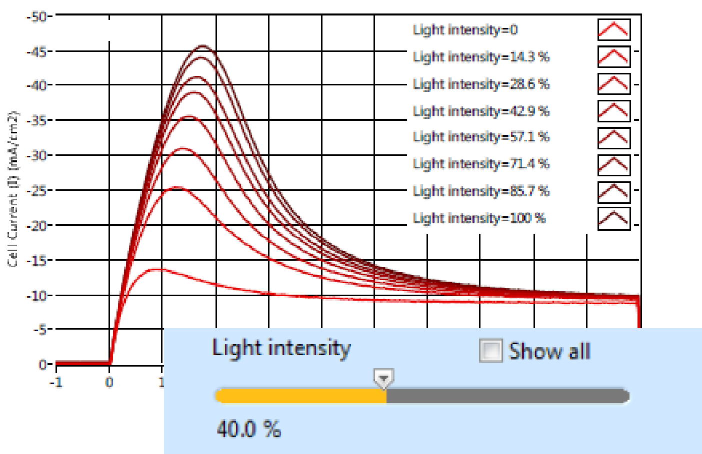




除了常用的测试信号用户可以通过公式自己制定任意波形测试电压，光强信号。用户可以对量测结果进行log，ln，exp，sin，x²，1/x，1/x²，√x，1/ √x，1-x，1-x²各种数学关系式绘图

由于薄膜器件普遍存在RC效应，对于新型瞬态量测技术一般产生明显的干扰，**Paios**具备提取Rs串阻，Cgeo几何电容程序，进一步计算位移电流经过RC效应的修正而获得正确的电流。



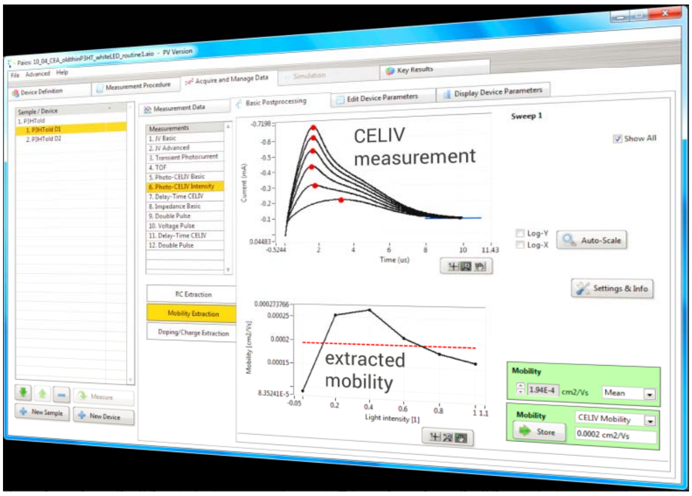


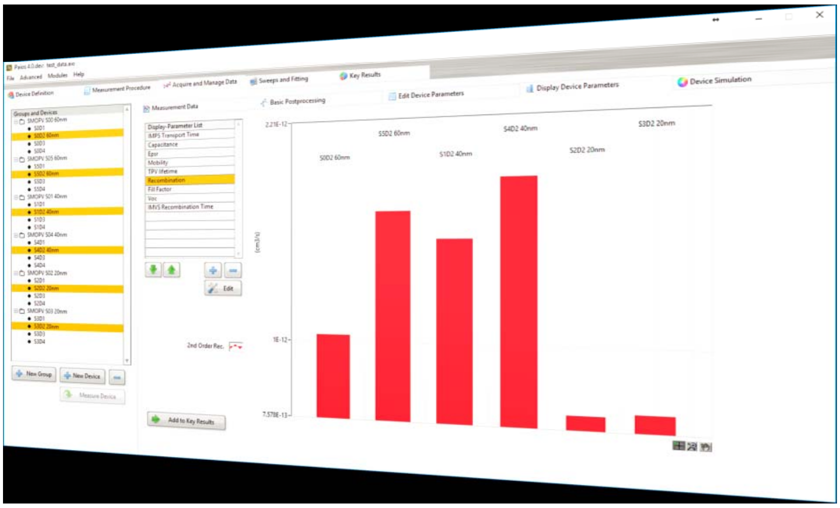
可以随时对器件进行预处理，钙钛矿电池在**Paios**预先偏压条件下呈现更稳定，重现度高的量测结果，另外IV曲线也随本身内部条件可能呈现迟滞现象，所以需要预处理才能量测想要的信号。

Paios可以进行参数扫描量测，一次性量测得到不同参数下的量测结果；
Paios不仅是Steady state稳态，Transient瞬态，AC交流信号等多合一自动化功能超强量测仪器，更具备测试资料管理，结果比较，输出高品质eps，png，ms-word，PDF等格式可以用于出版的结果资料

Paios 4.X

Paios强大的数据后处理拟合功能

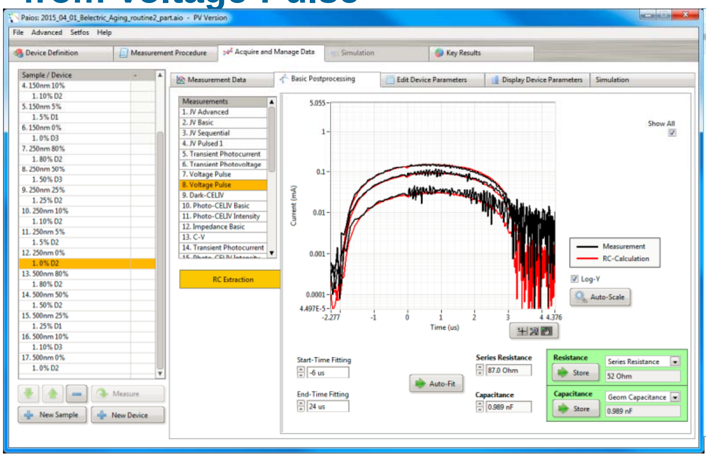




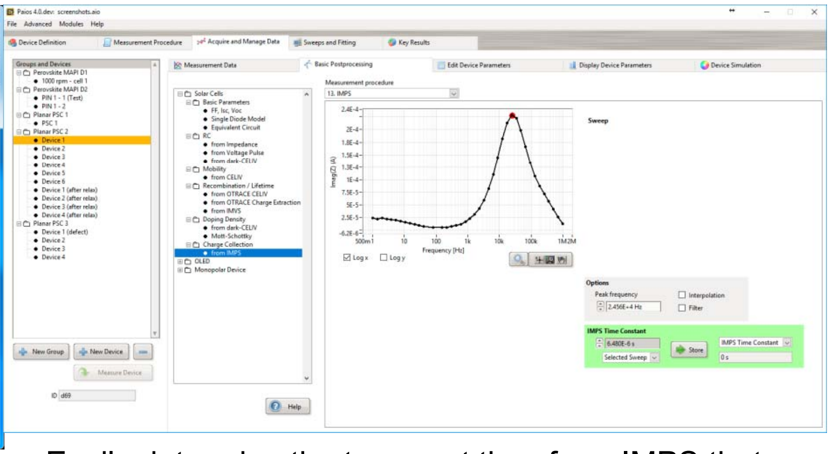
Paios软件中内建强大的数据后加工处理程式，可以进行各种量测技术的数据后加工获得进阶参数，！！

不同器件在不同量测技术下的量测结果可以在Paios软件内直接比较

Series Resistance and Permittivity from Voltage-Pulse



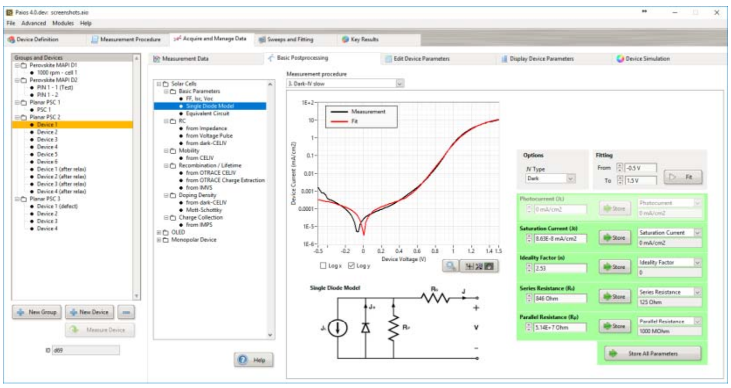
Transport-Time from IMPS Lifetime from IMVS



Determine the permittivity/capacitance and the series resistance from **a small voltage pulse** in reverse

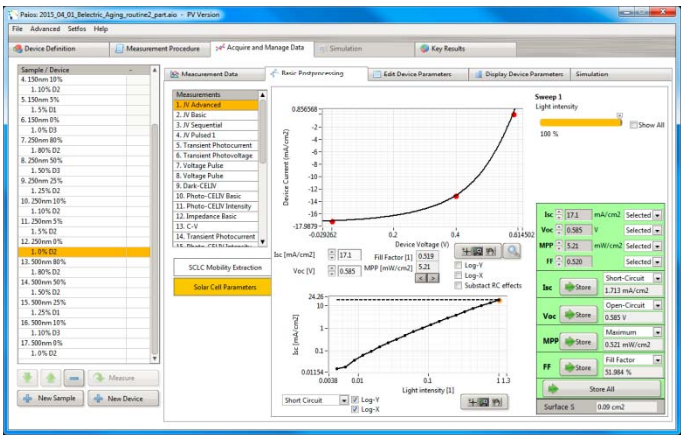
Easily determine the transport time from IMPS that describes how fast charges reach the contacts. From IMVS the charge carrier lifetime is determined.

One-Diode Model Fit



Extract the parameters of the one-diode model for solar cells: ideality factor, dark saturation current, series resistance and parallel resistance.

Basic Solar Cell Parameters

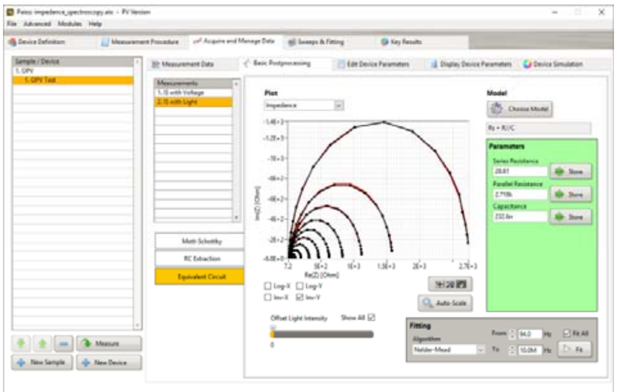


Extracts short-circuit current, the open-circuit voltage, the fill factor and the maximum power point of a solar cell

Paios 4.X

Paios强大的数据后处理拟合功能

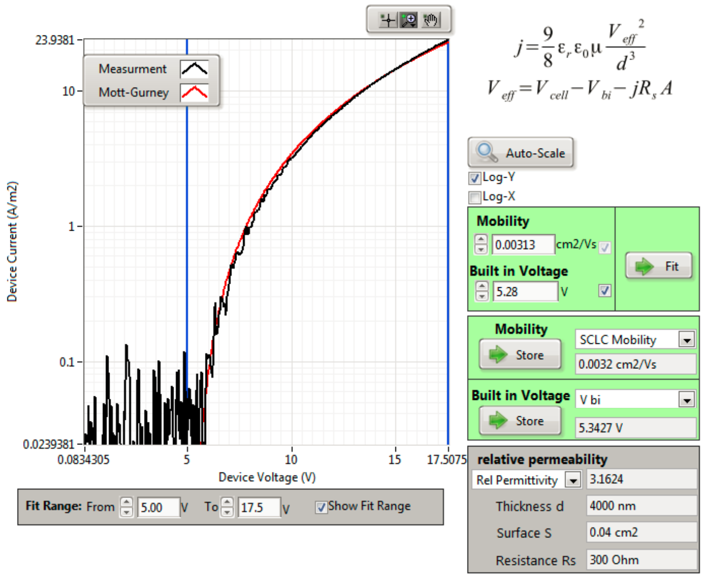
Equivalent Circuit Fitting



The most popular way to analyze impedance spectroscopy data is equivalent circuit fitting. **Paios** has integrated a routine for such fits.

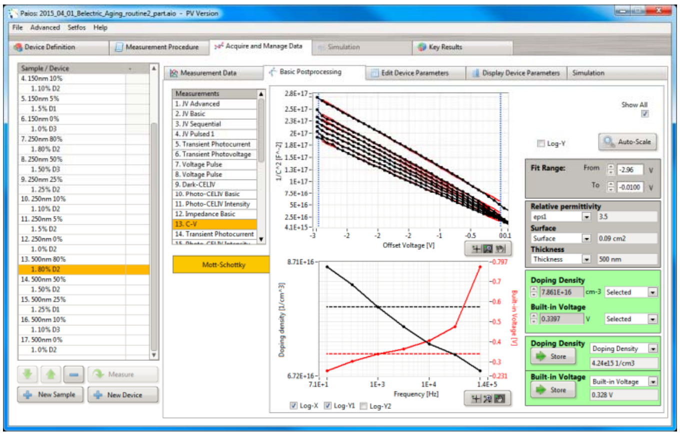
User-defined or pre-defined circuits are available.

Charge Carrier Mobility from Mott-Gurney Fit



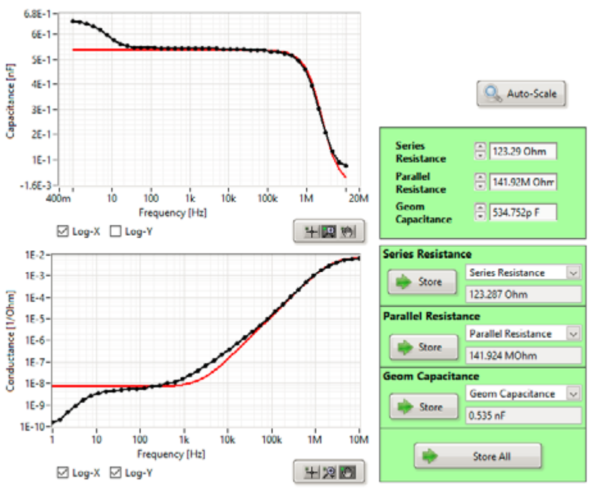
In monopolar devices the charge carrier mobility can be extracted from an IV-curve using a SCLC-fit.

Mott-Schottky Doping Density from CV



With a Mott-Schottky analysis the doping density of a semiconductor can be extracted from CV measurements (provided the device is thick enough).

Series Resistance and Geometric Capacitance from Impedance

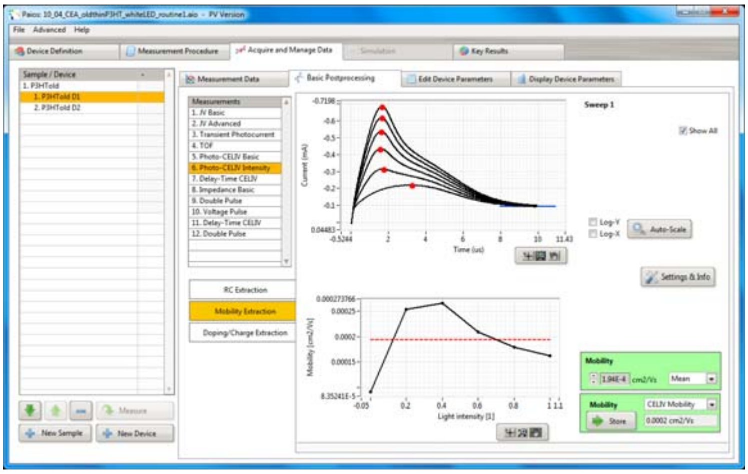


A very reliable method to extract the series resistance and the geometric capacitance from impedance spectroscopy data

Paios 4.X

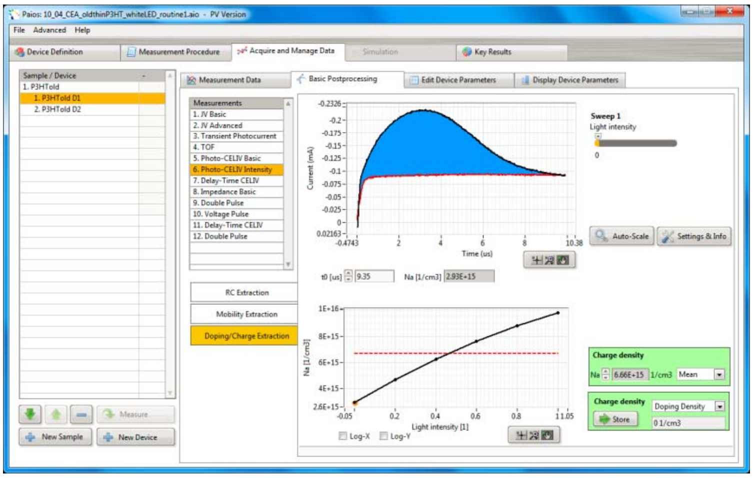
Paios强大的数据后处理拟合功能

Charge Carrier Mobility from CELIV



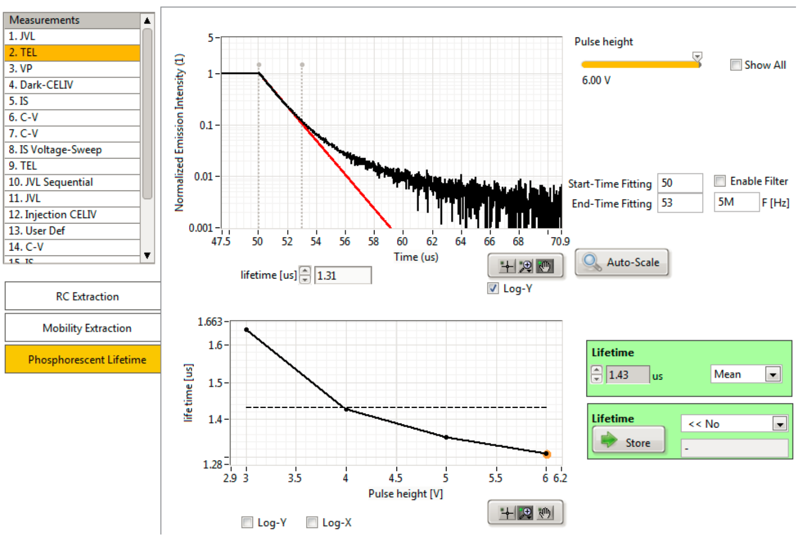
Extract the charge carrier mobility from **CELIV** experiments. The user can choose between several formulas to evaluate the mobility.

Doping Density from CELIV



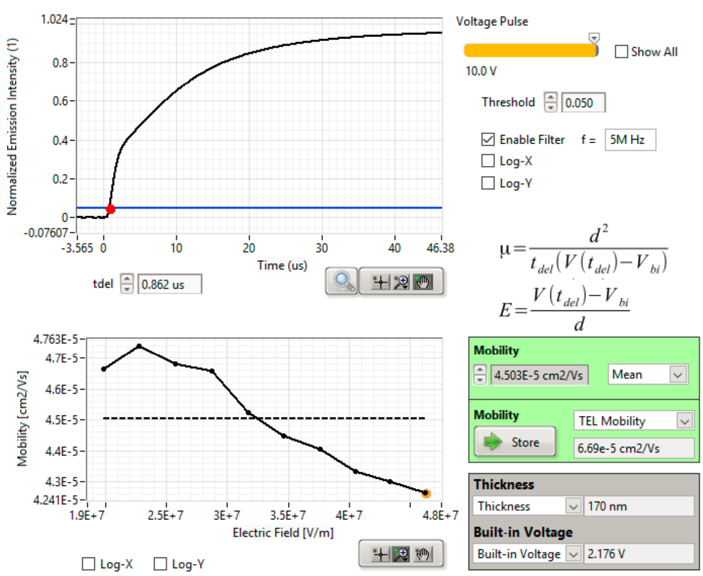
The dark-CELIV current overshoot (shown in blue) is integrated to obtain the doping density.

Luminescence Lifetime



From the electroluminescence decay after voltage turn-off the luminescence lifetime of the emitter can be extracted.

Mobility from Transient Electroluminescence



Extracts the charge carrier mobility from the delay time between voltage and EL turn-on.

Paios 4.X

SPI--Setfos与Paios结合：唯一的参数提取，扫描优化拟合功能

Numerical simulation helps to understand your measurement results.Therefore we integrated our simulation software **Setfos** seamlessly into the **Paios** software

- Perform simulations of all **Paios** experiments
- Simulate **OLEDs** and **solar cells**
- Compare simulation and measurement directly in the **Paios** software
- Use our **global fitting** routine to extract device and material parameters
- Easy-to-use software interface

SPI：基于强大数据库及坚实模型，Setfos已经成为有机光电OLED产业以及OPV有机太阳电池研究领域专用软件，Fluxim公司将Setfos 与Paios Integration（SPI）更是极有效辅助了许多传统测试技术无法达成的功能，如器件优化验证，老化机理了解掌握，等效电路拟合，参数提取R_s，R_p，C_{geo}，掺杂浓度，各种载子迁移率提取技术SCLC/TPC/CELIV/TEL/DIT，载子寿命IMPS/IMVS/TPV，复合系数，电池各种电性参数Isc/Voc/FF/Pm，电荷提取CE，二极管模型理想因子，暗电流，介电常数等.

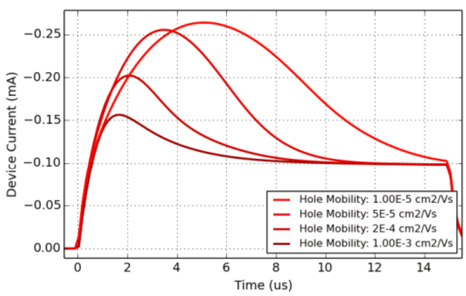
Parameter Extraction

Use the **Setfos-Paios Integration** to **extract** device and material parameters:

- electron and hole mobilities
- recombination coefficients
- charge injection barriers
- built-in voltage
- doping densities
- trap depth
- trap density
- permanent dipole moments
- series resistance
- parallel resistance
- electrical permittivity
- ....

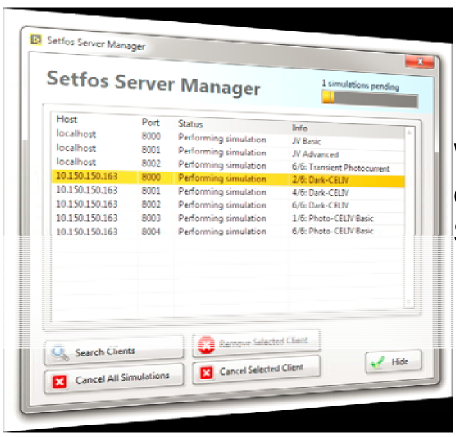
How Does a Material Parameter Influence an Experiment?

Use drift-diffusion simulation to analyze the influence of certain material parameters on an experiment. Easily **sweep** a simulation parameter to understand its influence.



Simulation of a photo-CELIV experiment with varied hole mobility.

Distributed Computing



With **the Setfos-Paios Integration** calculations can be distributed on different computers over the network.
Save time by running simulations in parallel on different computers

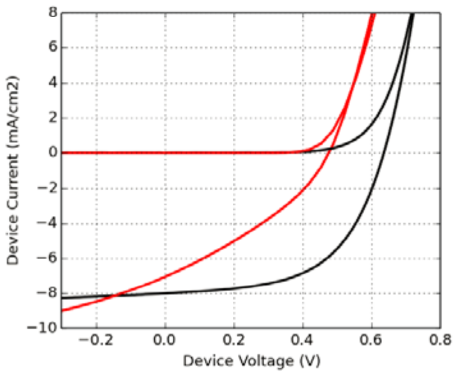
Paios 4.X

SPI--Setfos与Paios结合：唯一的参数提取，扫描优化拟合功能

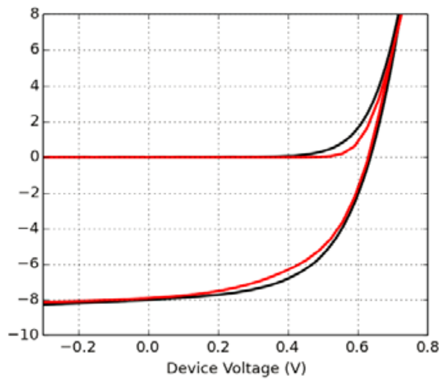
What is Fitting?

Fitting is a process where simulation parameters are adapted such to bring measurement and simulation result in agreement.

Fitting is used to extract parameters from experimental results.



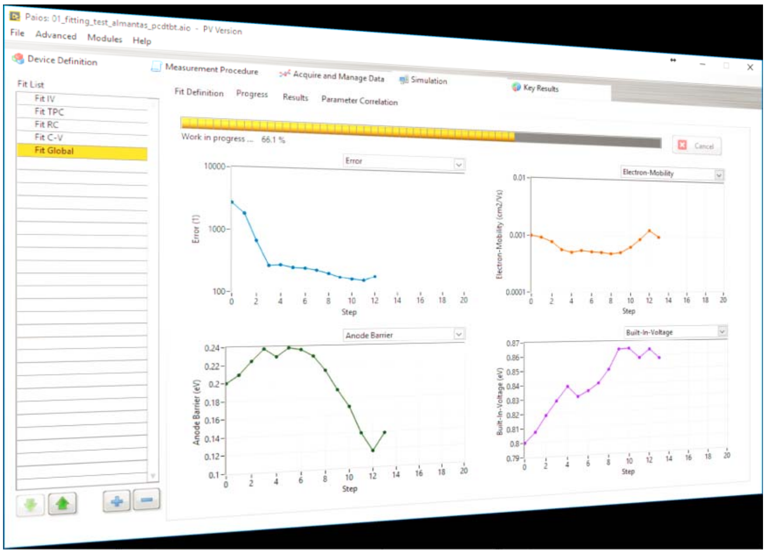
IV-curve simulation (illuminated and dark) with initial parameter-set.



IV-curve simulation (illuminated and dark) after fitting.

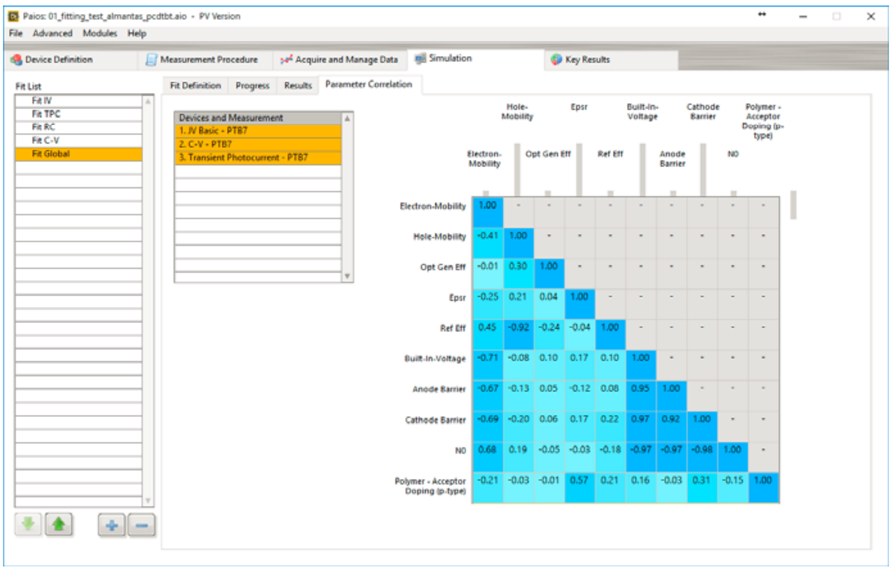
Global Fitting of Experimental Results

If more than one experiment type is fitted simultaneously, this is called global fitting. The **Paios** software optimizes parameters in order to fit several experiments.
The user defines the targets (what to fit) and the parameters to optimize. The software does the rest.
Use global fitting to extract device and material parameters reliably and with **increased accuracy.**



What is Parameter Correlation?

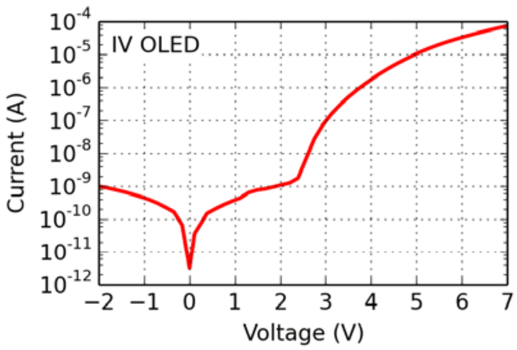
Global fitting功能使得**Paios**可以实现对多于一个参数的同时拟合**fitting**，然后自动计算给出这些参数之间的相关性**Parameter Correlation**
并以矩阵的方式呈现给使用者。
通过相关矩阵使用者可以判断提取出来的参数是否可靠！
当两个参数相关性很强时意味着他们对模拟结果有着相同的影响效果此种情况下提取出来的参数就不是唯一的,可靠性不高！



Paios 4.X

Paios与众不同的量测技术

IV – Current-Voltage Characteristics



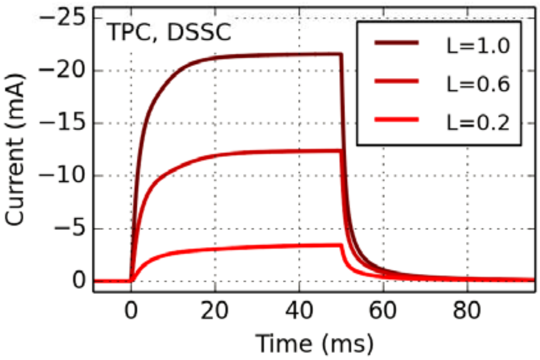
I-V特性曲线是OLED器件或者OPV器件最常见的量测技术. OLED器件除了I-V特性量测之外也会量测发光也即是　I-V-L曲线

Available Post-processing Routines

- Extracting the emission onset voltage of an OLED
- Extracting the mobility of a monopolar device from Mott-Gurney analysis (SCLC)
- Extracting the parameters of the one-diode model
- Extracting FF, Isc, Voc and MPP of a solar cell

- Voltage range -10 V to +10 V
- Current resolution < 100 pA
- For solar cells and OLEDs

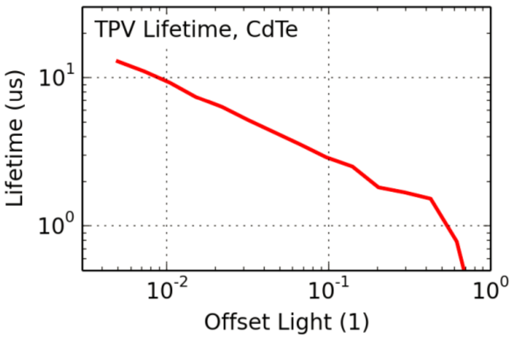
TPC – Transient Photocurrent



TPC量测技术量测瞬态光电流，主要用于量测有机太阳能电池. 通过TPC上升曲线和下降曲线可以得到载流子移动率Mobility，以及研究器件的trapping动态等.

- Pulse length: 1 μs to 1000 s
- Offset voltage -10 V to +10 V
- For solar cells

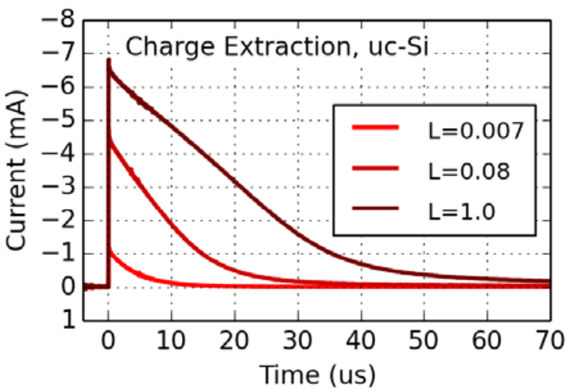
TPV – Transient Photo-voltage



与TPC量测技术类似，也是量测器件在光脉冲下的相应，主要用于量测有机太阳能电池. 次量测技术中有机太阳能电池处于开路状态。通过**TPV**下降曲线可以得到载流子lifetime

- Automatic calculation of the charge carrier lifetime
- For solar cells

CE – Charge Extraction



CE量测技术主要用于量测有机太阳能电池，量测时电池先处于开路状态并进行光脉冲照射，当光脉冲关闭时同时将电池片切换至短路状态进行提取电荷，此技术用来获取器件内的电荷载子浓度

- For solar cells

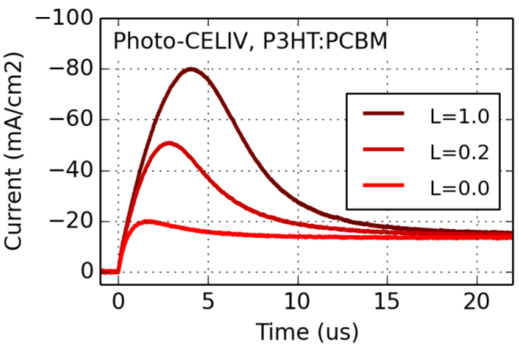
Available Post-processing Routines

- Extracting the recombination coefficient from charge extraction with varied delay time similar as in OTRACE.

Paios 4.X

Paios与众不同的量测技术

CELIV – Charge Carrier Extraction with Linearly Increasing Voltage



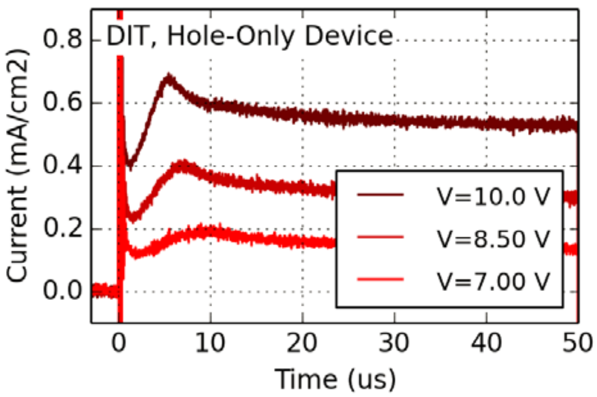
CELIV技术是比较有名的提取载子移动率，复合系数，掺杂浓度等参数的技术。**CELIV**在有机太阳能电池量测上很有名气，但是它也可以量测钙钛矿电池以及**OLED**器件。给器件施加反向的斜率上升电压，可以提取器件内的载子，获取的电流-时间曲线的峰值位置与载流子移动率有关，用来计算载流子移动率

- For solar cells, MIS and OLEDs

Available Post-processing Routines

- Extracting the charge carrier mobility
- Extracting the doping density from dark-CELIV measurements
- Extracting the geometrical capacitance and the series resistance from dark-CELIV
- Extracting the recombination coefficient of solar cells from OTRACE CELIV

DIT – Dark Injection Transients



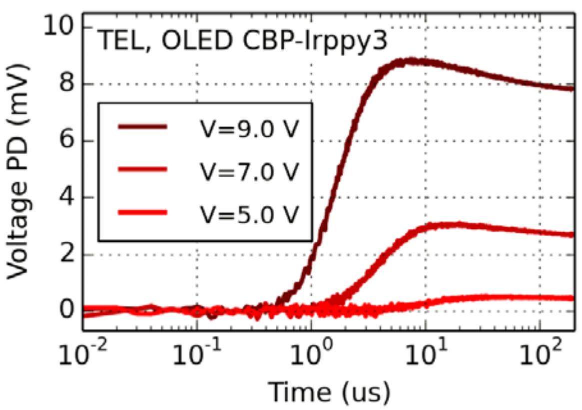
DIT量测技术主要用于量测单载子器件并获取载子的移动率，量测时给器件加一个短的电压脉冲量测器件的瞬态响应电流，通过响应电流峰值位置的时间来计算得到载子移动率

- For mono-polar devices, solar cells and OLEDs

Available Post-processing Routines

- Extracting the series resistance and geometric capacitance

TEL – Transient Electroluminescence



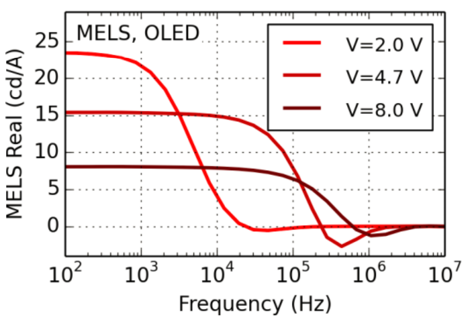
TEL量测技术主要用来量测**OLED**器件并获取载流子移动率以及磷光寿命等，量测时也是给器件加一个短脉冲电压量测瞬态**EL**信号，通过**EL**信号时间跟施加电压信号时间之间的**delay time**可以计算出载子移动率。分析**EL**信号的衰减曲线可以得到磷光寿命

- For OLEDs and highly efficient solar cells

Available Post-processing Routines

- Extracting the average charge carrier mobility
- Extracting the PL lifetime

MELS – Modulated Electroluminescence Spectroscopy



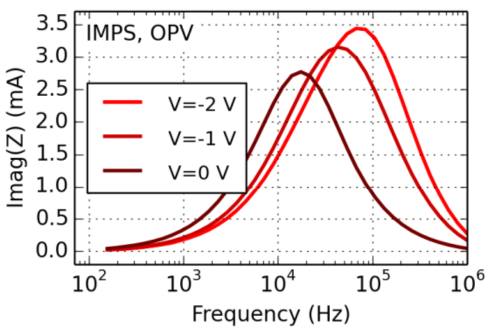
同**IS**量测技术类似给器件施加的直流偏置电压上叠加一个小信号交流电压信号，但是量测的信号是不同频率下**EL**信号的相位和振幅。**MELS**用来研究**OLED**器件内电荷的传输情况

- Frequency range:10 mHz to 10 MHz
- Offset voltage -10 V to +10 V
- For OLEDs

Paios 4.X

Paios与众不同的量测技术

IMPS – Intensity Modulated Photocurrent Spectroscopy



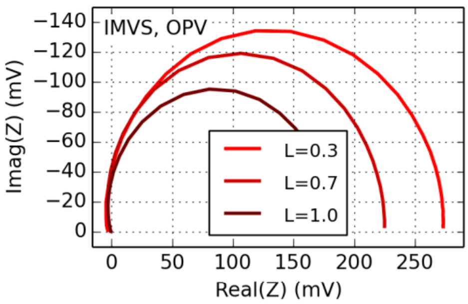
IMPS用来研究有机太阳电池内电荷的传输，太阳能电池处于短路状态时被恒定光强度光信号照射，恒定强度光信号照射时同时叠加一个小的调变光信号，量测不同频率下短路电流的振幅跟相位

- Frequency range:10 mHz to 1 MHz
- Offset voltage -10 V to +10 V
- For solar cells

Available Post-processing Routines

- Extracting the charge transport from the IMPS peak

IMVS – Intensity Modulated Photovoltage Spectroscopy



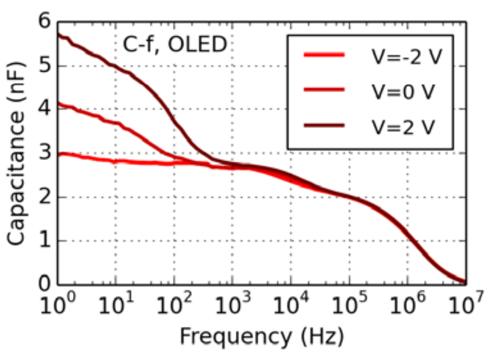
IMVS量测技术与IMPS技术类似，不同点在于电池片处于开路状态，主要用来提取电池片内部电荷的寿命。

- Frequency range:10 mHz to 1 MHz
- For solar cells

Available Post-processing Routines

- Extracting the recombination time from the IMVS peak

IS - Impedance Spectroscopy

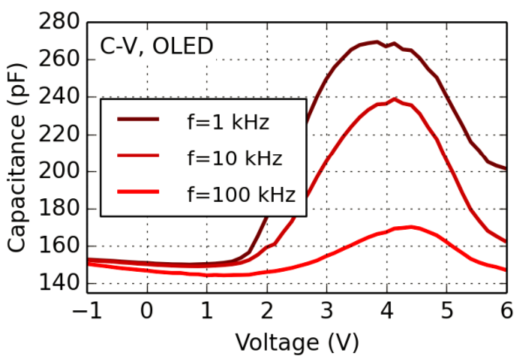


IS量测技术是一种广泛应用的量测技术，既可以量测OPV也可以量测OLED研究这些器件的电荷动态特性。
给器件施加的直流偏置电压上叠加一个小信号交流电压信号，量测不同频率下电流信号的相位跟振幅进而得到器件的复阻抗谱。

Available Post-processing Routines

- Frequency range:10 mHz to 10 MHz
- Impedances up to GΩ
- Offset voltage -10 V to +10 V
- For solar cells and OLEDs
- Fitting with Equivalent-Circuits
- Extracting series resistance, parallel resistance and the geometric capacitance

CV - Capacitance-Voltage



CV量测技术是量测器件的阻抗时让频率固定，直流偏置电压做扫描进而得到器件的C-V曲线。
C-V曲线可以得到器件的内建电场，以及注入能障等信息。

- Offset voltage -10 V to +10 V
- For solar cells and OLEDs

Available Post-processing Routines

- Extracting the doping density by Mott-Schottky analysis

Paios 4.X

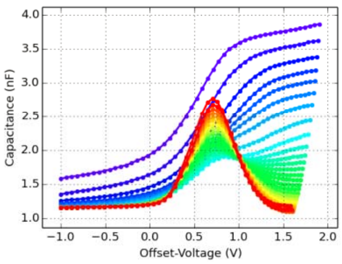
Paios各种应用的选项模块

Low Temperature Module

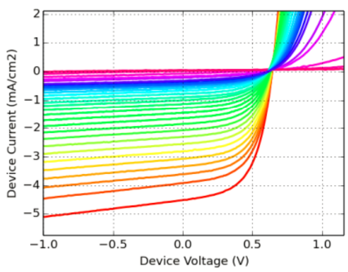
- Paios所有量测实验都可以在低温条件下进行
- 自动温度控制以及获取数据
- 液氮冷却系统
- 测量腔体内有氮气保护器件老化并防止冷凝
- 光照光源是LED，光探测器量测亮度
- 可以评估器件的热稳定性通过阶梯升高温度

Temperature range: **-150˚C to +200˚C**
Dewar size: 2 L
Filled dewar lasts for: 4 h
Maximum temperature ramp: 30 K/min

Stress-Test Module

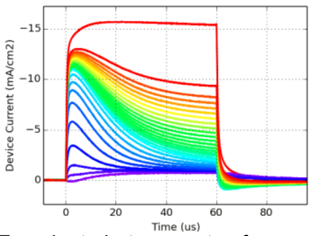


Capacitance-Voltage curves of an organic solar cell at different degradation stages.



Current-voltage characteristics of an organic solar cell at different degradation states.

•监控器件的老化
•给器件施加恒定电流，电压，或者光照信号进行老化实验
•全自动化老化实验操作以及数据量测
•可以获取高一致性数据
•探寻并理解器件老化原因



Transient photocurrents of an organic solar cell at different degradation stages

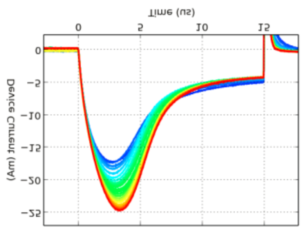
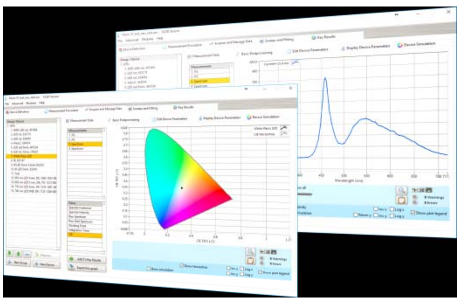


Photo-CELIV measurements of an organic solar cell at different degradation stages.

Spectrometer Module



•量测OLED器件发光光谱
•光谱仪经过校准的
•自动对暗光谱进行修正
•可以跟自动测量台整合

Spectral range: 360 – 1100 nm
Integration time: 1 ms to 10 min
Post-processing quantities: luminance, radiance, EQE, lm/W, CRI, CIE coordinates

Paios 4.X

Paios各种应用的选项模块

Voltage Extension Module (SMU Module)

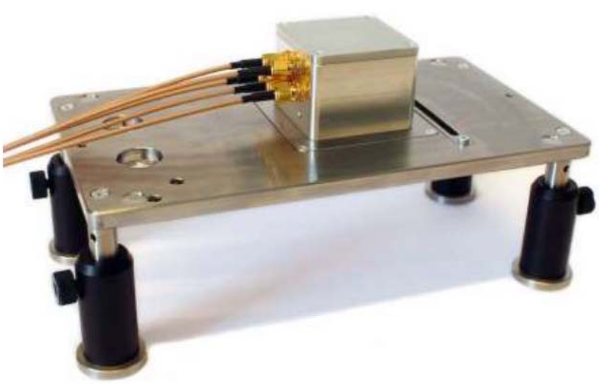
• SMU模块可以使施加器件电压高达±60V

Voltage range: ±60 V
Min measurable current: 1 pA
Frequency range impedance: 10 mHz to 1 kHz
Sampling Frequency: 100 kS/s

Multiplexing Module

• 一次性同时量测4个器件
• 与定制夹具搭配使用

Customized Sample Holder

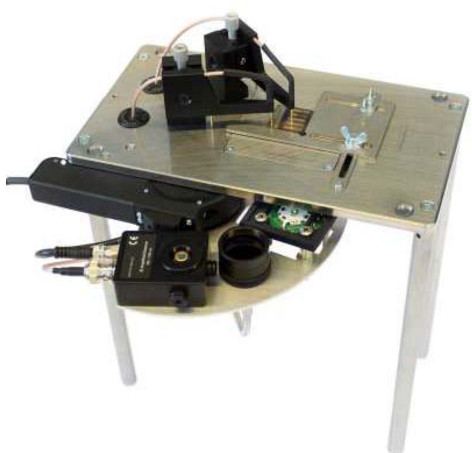


•根据客户需求进行定制
•可以最多连接4个器件
•也可以与自动测量台搭配使用
•当需要在手套箱里工作时非常有用

Glovebox Feed-Through

•Paios可以放在手套箱里使用
•根据客户需求定制线缆连接器

Automated Measurement Table



•自动测量台可以自动在光探测器，LED光源，光谱仪之间进行切换
•对于有机太阳电池可以将Sun simulator放在测量台底部搭配使用，并且自动切换
•对于OLED可以量测OLED的EL和光谱，不必手动切换光探测器和光谱仪，所有都是自动进行

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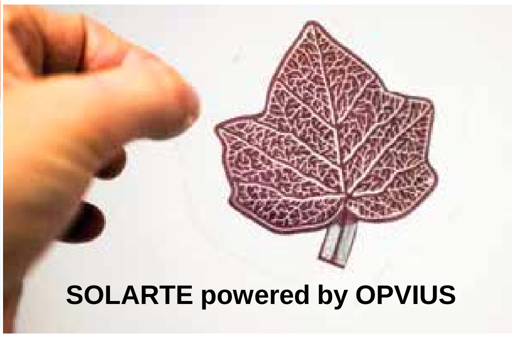
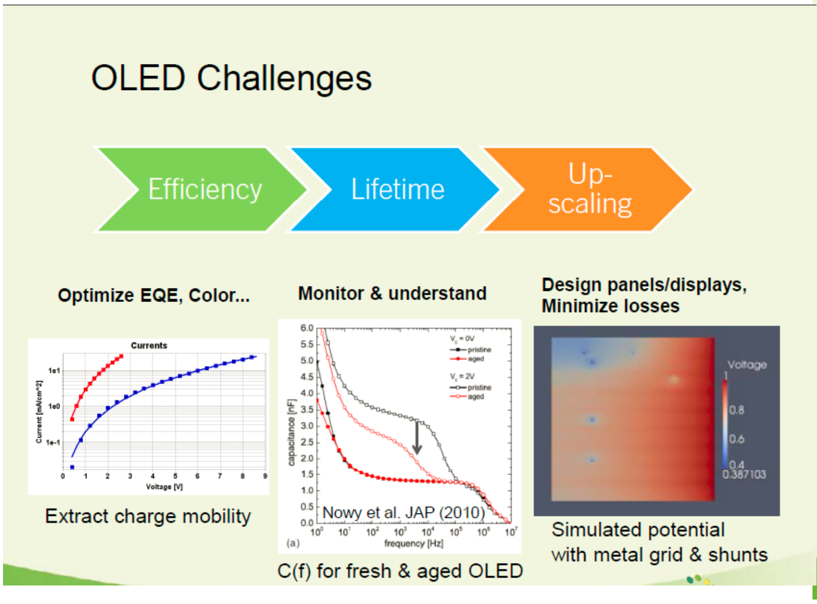
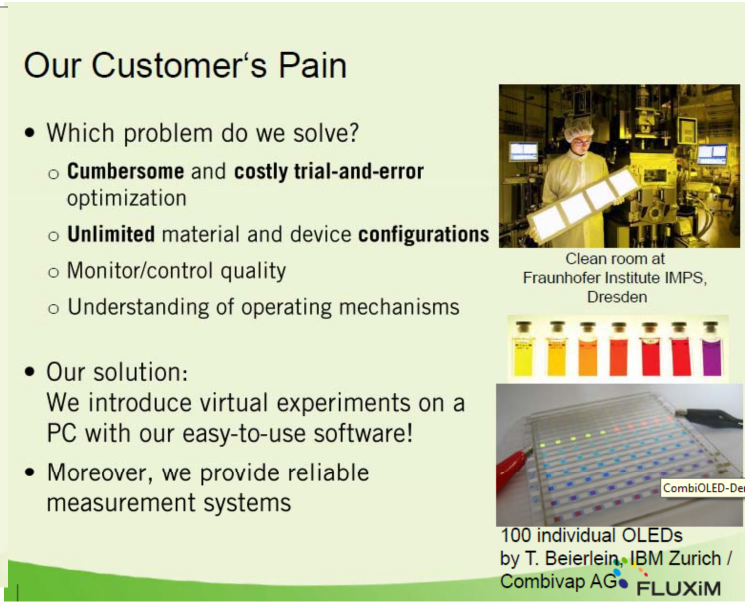
OLED Displays

OLED Lighting



Next Generation Photovoltaics



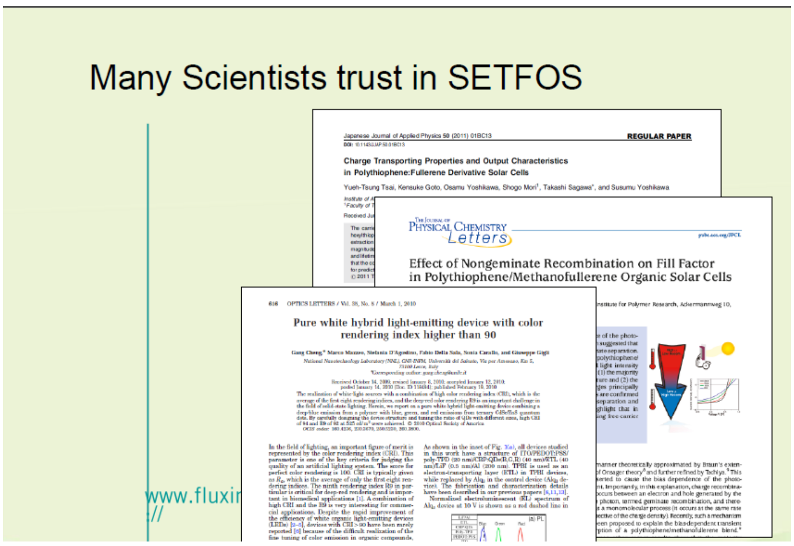


OLED的挑战：

1）效率的提升
2）器件寿命需要提高
3）大尺寸

客户的痛以及我们解决哪些问题：

1）避免了繁杂的和昂贵的的反复试验优化
2）提供无限量的材料和器件配置实验
3）便于质量监控和控制
4）提供更深层次了解器件的运行机制的途径



Setfos在业界得到广泛的好评，并且很多科学家都相信Setfos的模拟结果并在发表文献中积极引用Setfos！

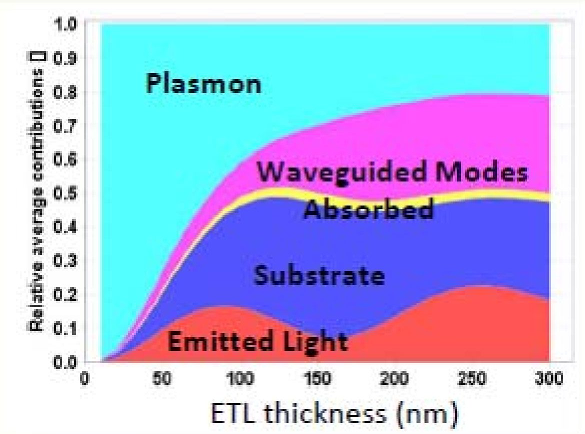
Setfos 4.X

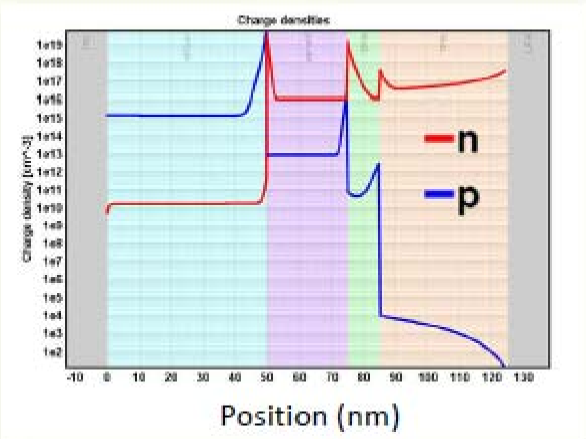
Setfos是业界最先进的仿真软件，目前有4个模块

Emission ⟷ Drift-Diffusion

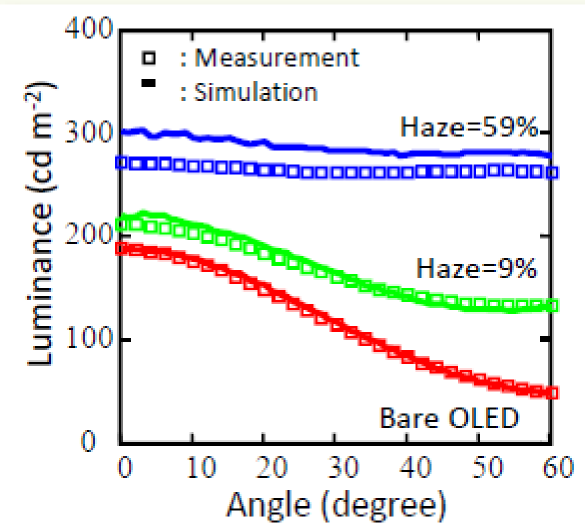
- Dipole emission
- Full spectrum, CIE coordinates
- Thin film, color filter & substrate optics
- Mode analysis

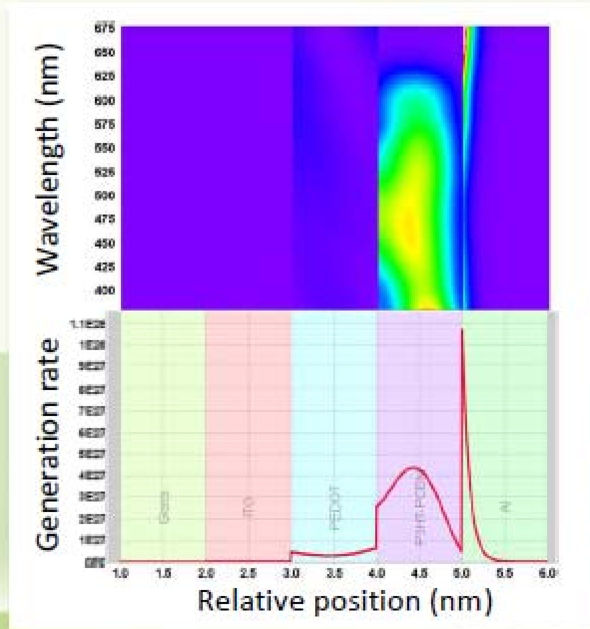
- Charge transport & recombination
- Exciton physics: decay, diffusion, interaction, TADF, transfer, saturation
- Advanced transport models: traps, doping, EGDM
- Multi-layer steady-state, transient & AC modeling





Advanced Optics ⟷ Absorption





额外特性功能

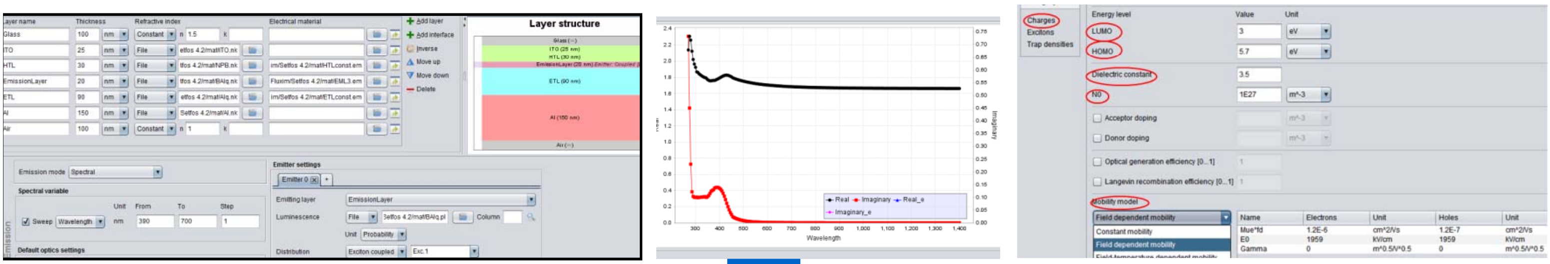
Use the **optimization** toolbox to improve your device or to find physical parameters.

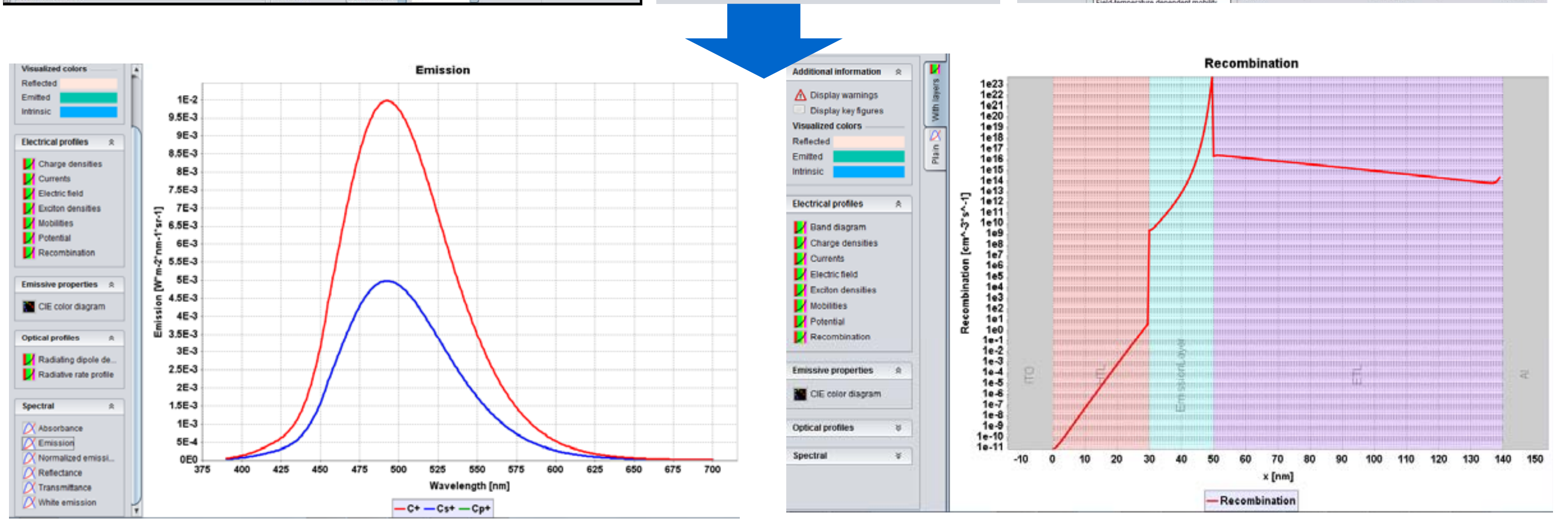
Sweep material parameters to analyze their influence on the device performance

Fit emission spectra to reconstruct the dipole distribution and optionally extract the intrinsic luminescence spectrum of the emissive material

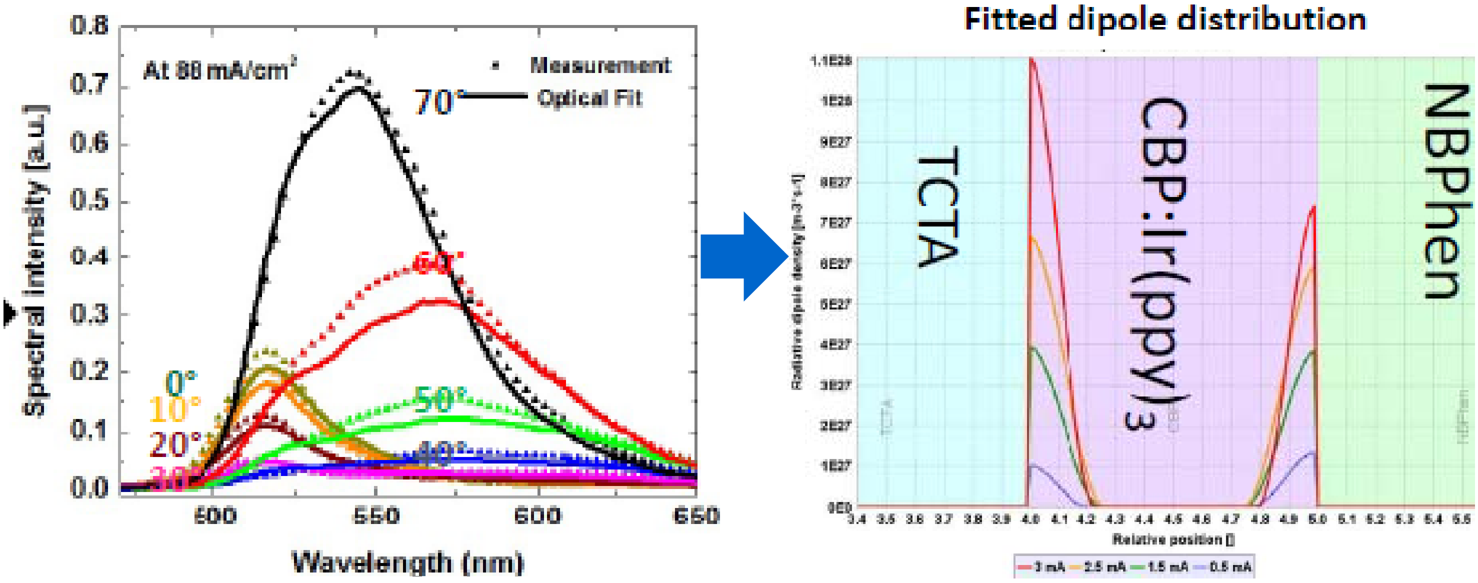
Setfos 4.X

[设定器件结构依材料参数,模拟电性出光,有参数可进行无限制材料器件配置实验]

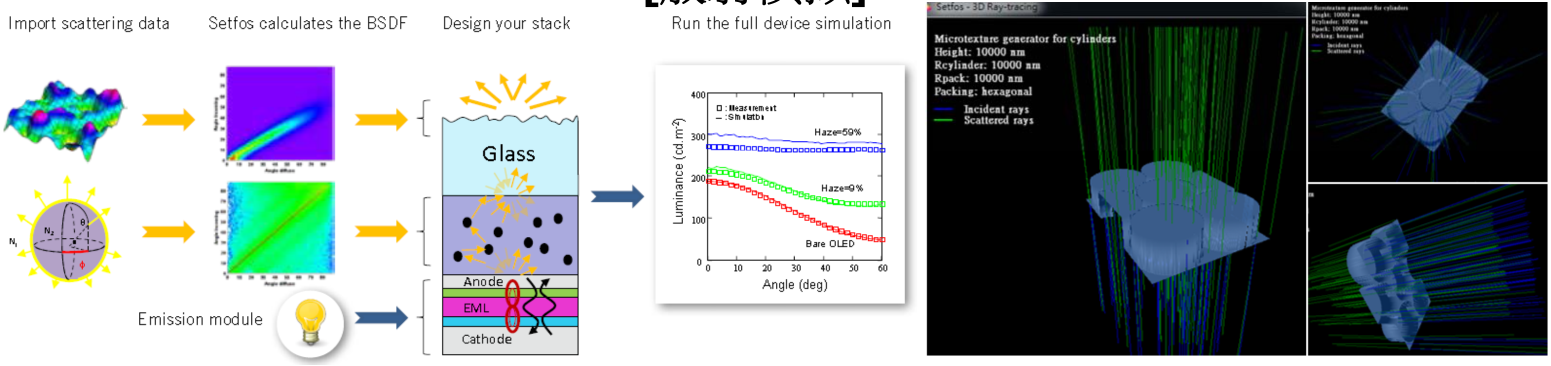




[可由量测发光光谱拟合发光层极子(dipole)分布]



[散射模拟]



GSI／台北廣集, HTTR／北京華通

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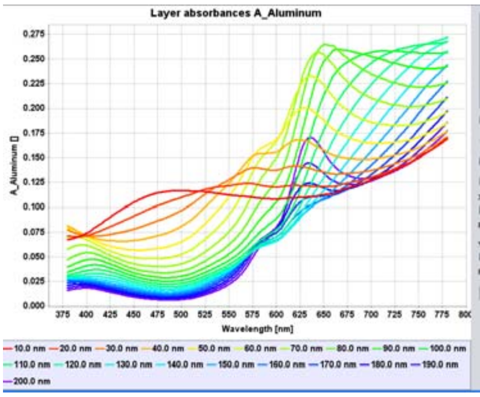
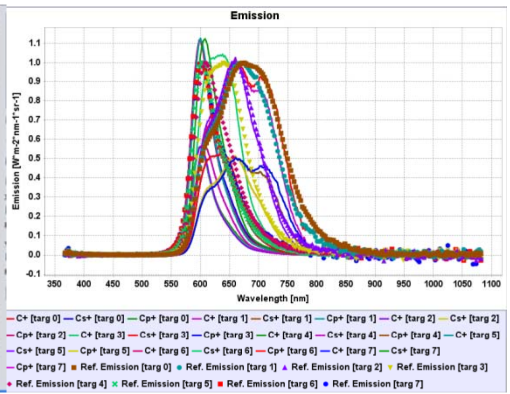
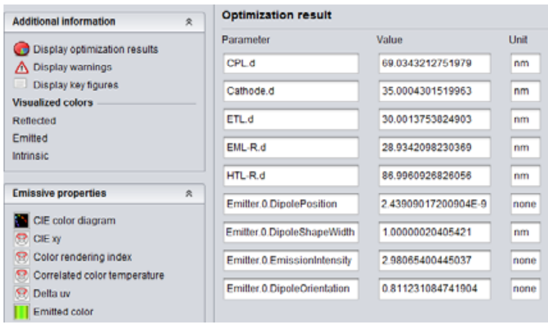
[扫描优化等功能模拟变化趋势与优化参数,避免了繁杂昂贵的反复实验]

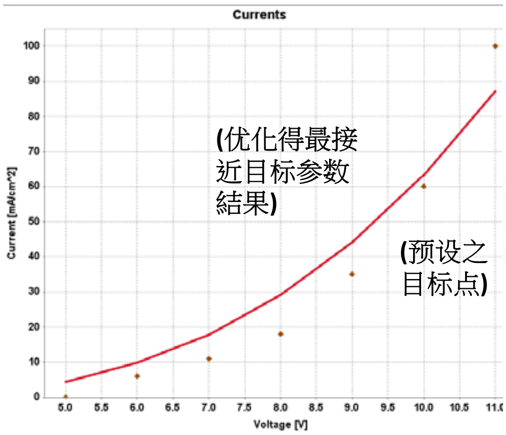


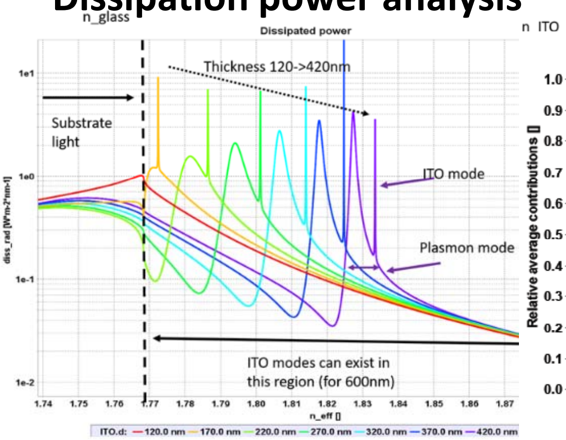


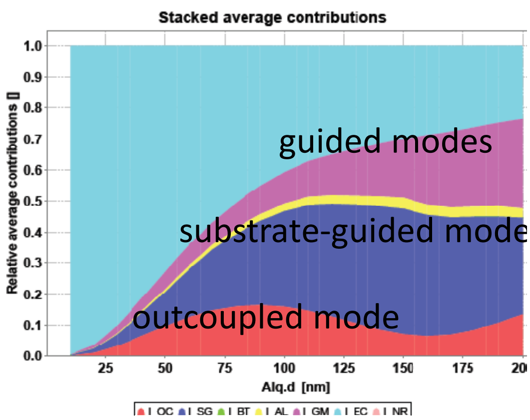


Dissipation power analysis

Mode analysis







[有机太阳能电池模拟]

THE JOURNAL OF PHYSICAL CHEMISTRY Letters (德国著名研究院Max Plank模拟)

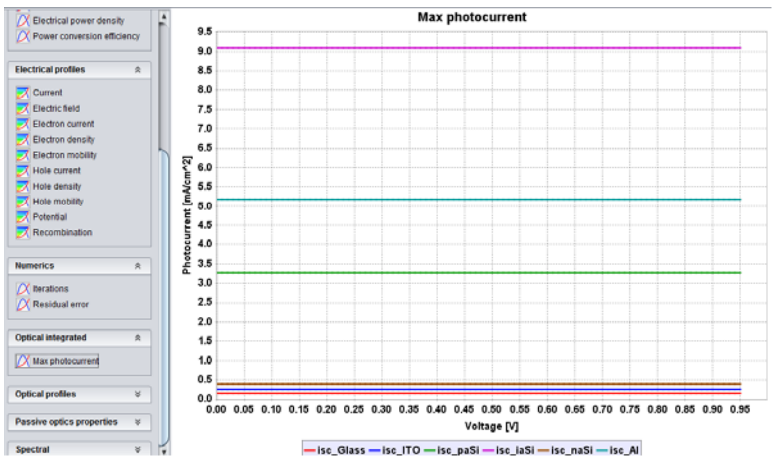
Effect of Nongeminate Recombination on Fill Factor in Polythiophene/Methanofullerene Organic Solar Cells

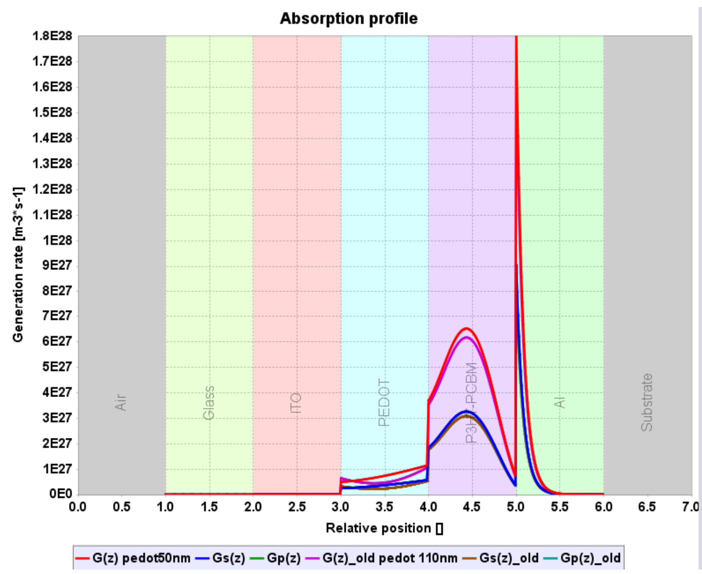
Ralf Mauer, Ian A. Howard,* and Frédéric Laquai*

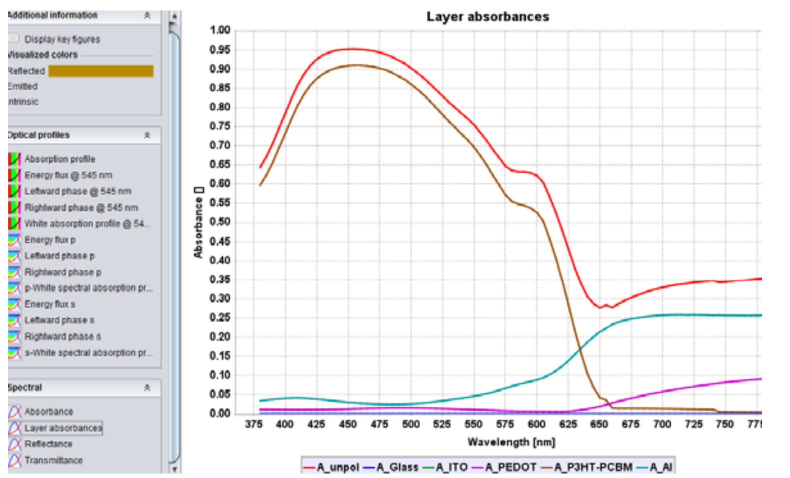
Max Planck Research Group for Organic Optoelectronics, Max Planck Institute for Polymer Research, Ackermannweg 10, D-55128 Mainz, Germany

temperature. For the intensity-dependent measurements, various neutral density filters were used to adjust the excitation.

Fully coupled optical and electronic simulations were performed using the commercial simulation software setfos 3 by Fluxim AG. For details, see ref 37. The model under study uses an ultrafast, temperature- and field-independent charge





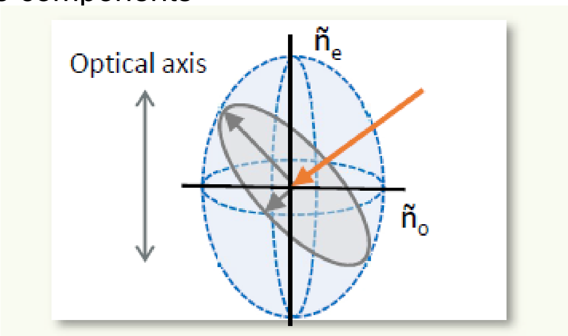


Setfos 4.X

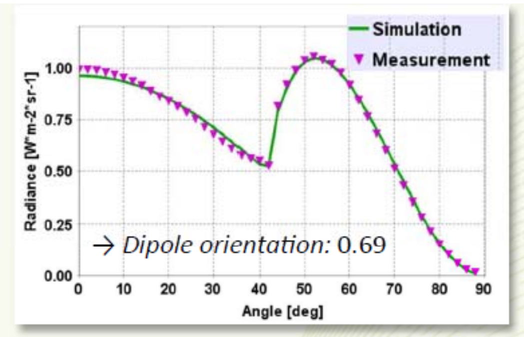
New Highlights of Setfos 4

Birefringent materials

• Simulate devices with layers employing a refractive index with ordinary ño and extraordinary ñe components

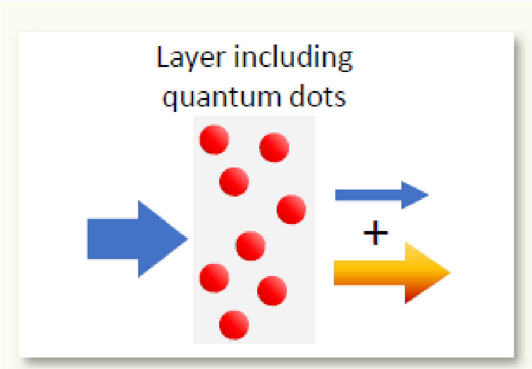


Determine the emitter orientation in a birefringent emitting layer

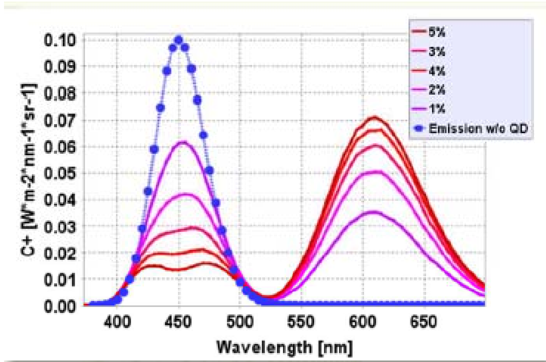


Quantum dots

• Include quantum dot down conversion in your optical simulation

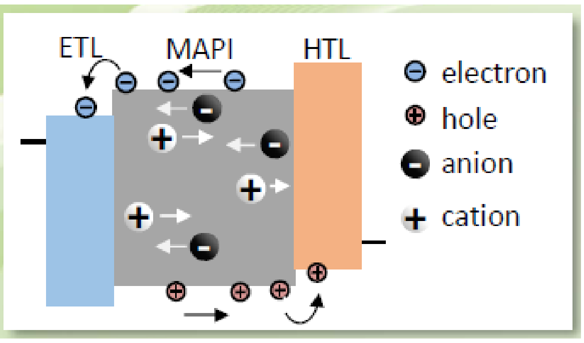


Analyze the effect of incorporating quantum dots in a color conversion film

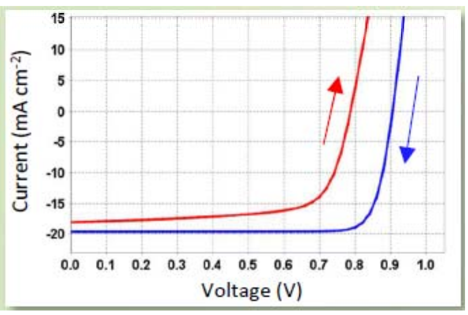


Mobile ionic charges

• Introduce mobile ions to simulate perovskite solar cells and light-emitting electrochemical cells

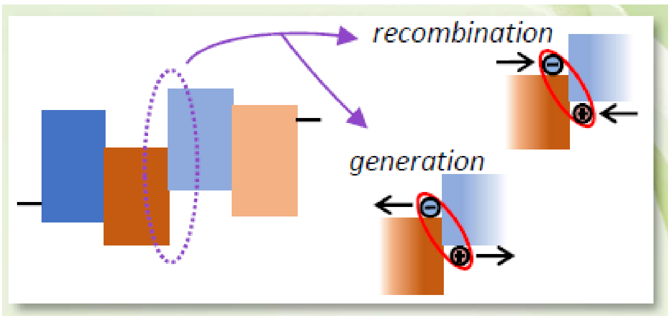


• Fully coupled steady-state and transient modeling
• Understand device operation from electronic & ionic charge profiles

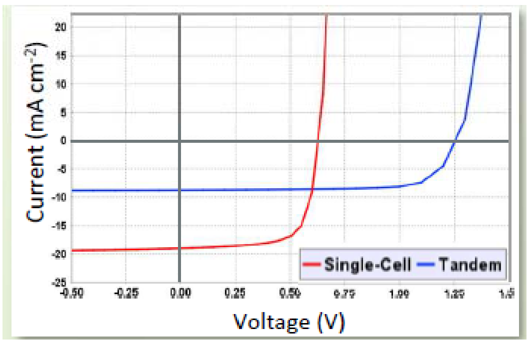


Interface recombination

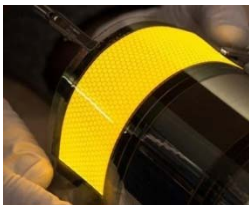
• Charge recombination and generation at organic/organic interfaces
• Advanced injection layer modeling

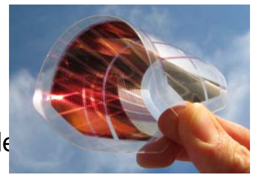


• Simulate tandem OLEDs and solar cells



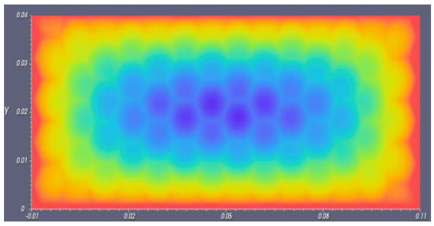
LAOSS





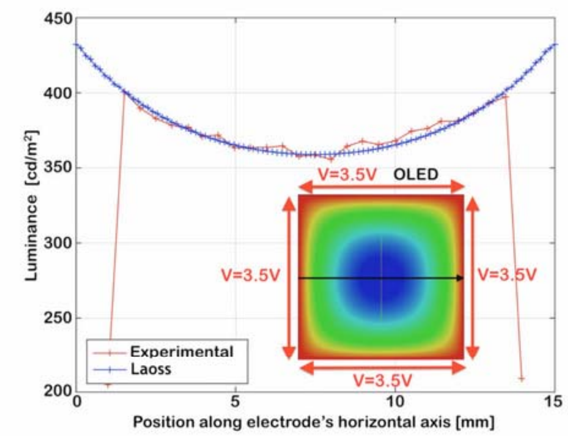
- ●Simulate large area devices such as OLEDs and photovoltaic cells or modules considering ohmic losses in the electrodes.
- ● Use a measured or simulated current-voltage (IV) law to couple the top and bottom electrode domains.
- ● Optimize the device by variation of electrode materials, geometry, etc.
- ● High speed computation with reduced degrees of freedom

- Fast calculation on standard PC
- Supports upscaling process from lab to fab



- Minimizes electrical losses

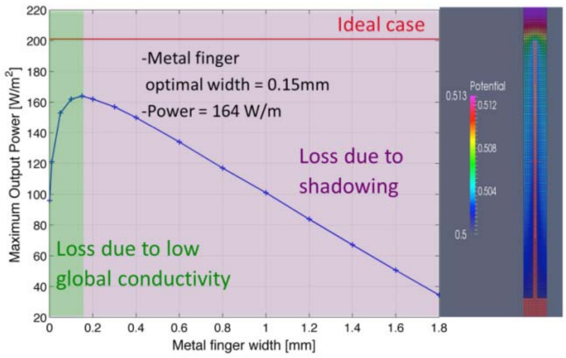
Experimental **Validation**



-Successful comparison with experimental results from literature

LAOSS：针对大面积OPV、OLED器件的专业模拟软件！！

Metal Grid **Optimization**



Design trade-off in conductive grids:

-Shadowing by metal lines

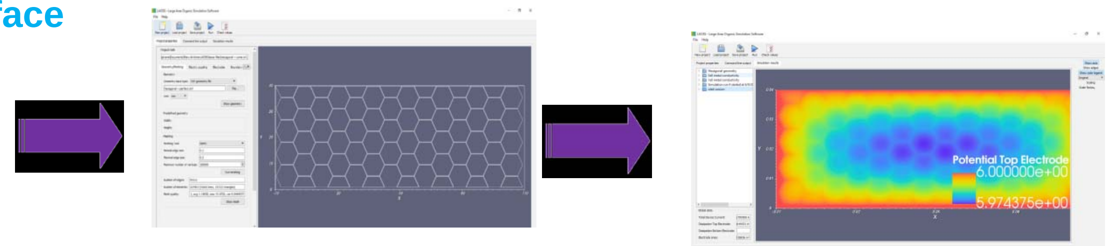
-Resistive performance losses without grid

Laoss allows to find the optimal finger width and spacing

-Simulate the optimal grid geometry

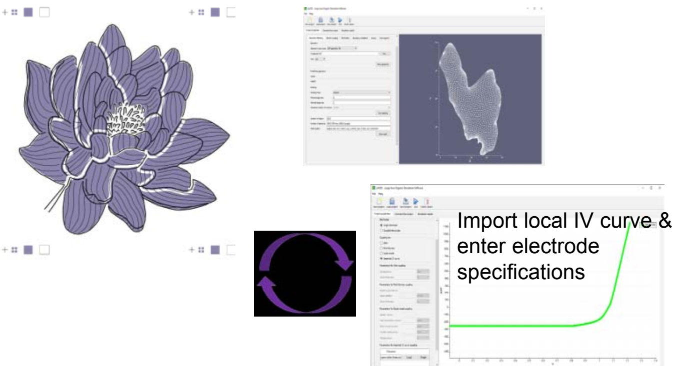
Intuitive Graphical Interface

- Import standard CAD files
- Easy to setup
- Fast learning curve
- Comprehensive visualization

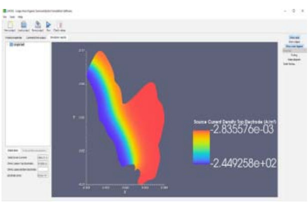


Free-form design idea of organic PV module by CSEM Switzerland [2]

Draw and import the device geometry, run meshing



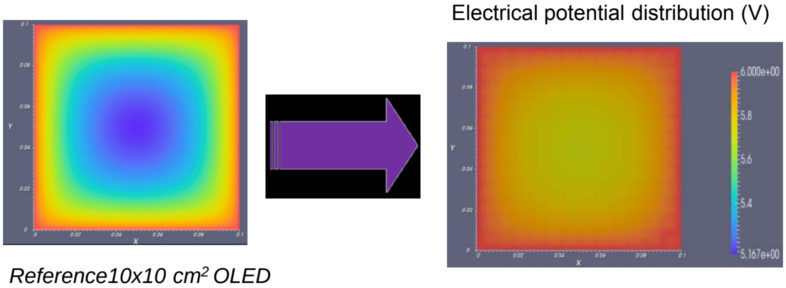
Import local IV curve & enter electrode specifications



Run the simulation

OLED Panel Optimization

Electrical potential distribution (V)



Reference10x10 cm^2 OLED without metal grid

OLED with a metal grid leading to more uniform potential

- Design electrodes for OLED panels with more uniform brightness
- Minimize ohmic losses and optical shadowing
- Improve the conductivity of the electrodes

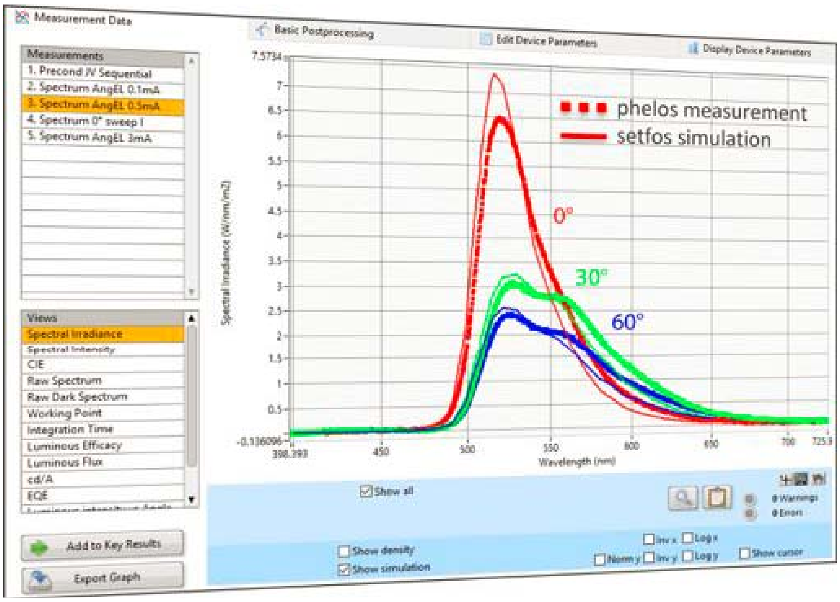
GSI／台北廣集, HTTR／北京華通

Phelos

phelos
angular luminescence spectrometer

- OLED efficiency
- Viewing angle
- Emitter orientation and position
- One-click operation

Phelos是针对OLED器件的发光特性量测而设计的，它可以量测再不同角度不同偏振下的器件的EL和有机材料PL光谱，再通过计算或者与Setfos模拟软件搭配获得OLED器件或者有机材料的其他参数，例如：IVL, EQE, lm/W, Cd/A, CIEx,y ,以及发光层材料dipole方向性，dipole分布情况，pl等。

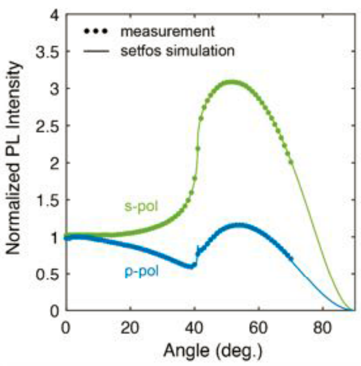


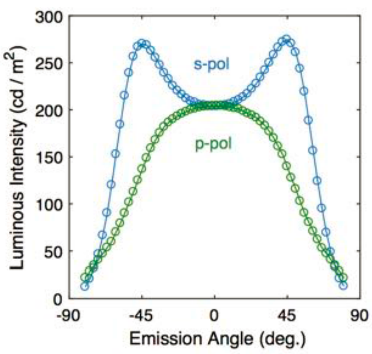
Measured quantities

- Efficiency: EQE, Lm/W and Cd/A
- Spectrum and color per emission angle
- Current-voltage-luminance (IVL) by integrated SMU
- Photoluminescence
- Polarization

Specifications

- **Angular range: -85˚ to +85, resolution: < 1˚**
- **Spectral range: 360 – 880 nm with 1.2 nm** resolution
- Polarizers and macro-extractor lens included
- Spot size: 100 µm – 5 mm





Advantages

- Easily couple measurement by **Phelos** with simulations by Setfos
- Determine **emitter** molecule **orientation and position**
- Combine experiment and simulation to analyze the internal operation of your devices
- Simulate measurement results by **integrated** optical **microcavity emission model**

Phelos系统的紧密设计使得其可以很容易放在手套箱中使用！！