Fourier Transform Photocurrent Testing System: FTPS

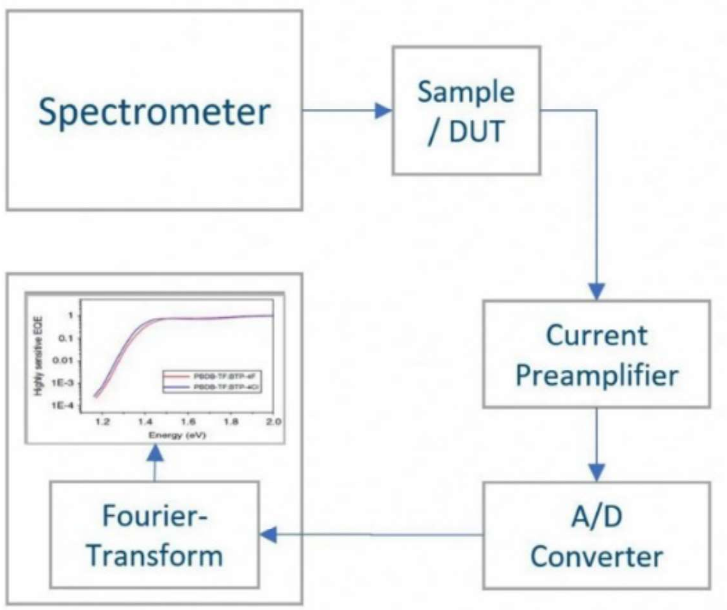
The Most Sensitive Photocurrent and EQE / IPCE System in the World.

Introduction

In semiconductor devices, imperfect crystallinity often causes defect or trap states in the forbidden bandgap, which greatly affect the overall optical and electrical performance of the device. Because the absorption coefficient in the bandgap is extremely low, the generated photocurrent signal is extremely weak as well. Therefore, a highly– sensitive detection system is required.

Enlitech's FTPS (Fourier Transform Photocurrent Spectroscopy) is a highly sensitive photocurrent and external quantum efficiency (HS–EQE) spectroscopy system. It utilizes Fourier Transform Signal Processing technology to enhance and breakthrough the photocurrent signal detection limits. The lowest EQE level can be as low as 10–5% (7 orders)*. FTPS can be applied to detect the tail states of perovskite solar cells, charge transfer state of organic solar cells, which are the key to improve Voc loss mechanisms. Another common application is the Urbach Energy measuring.

Setup of FTPS (model: PECT-600)



Working Principal of FTPS

The monochromatic light at each wavelength after the monochromator are illuminated on the device under test. The generated photocurrent passes through the current amplifier and is acquisition by the A/D conversion unit. The fast Fourier transform algorithm is used to reduce the noise and improve the signal–to–noise ratio.

Application

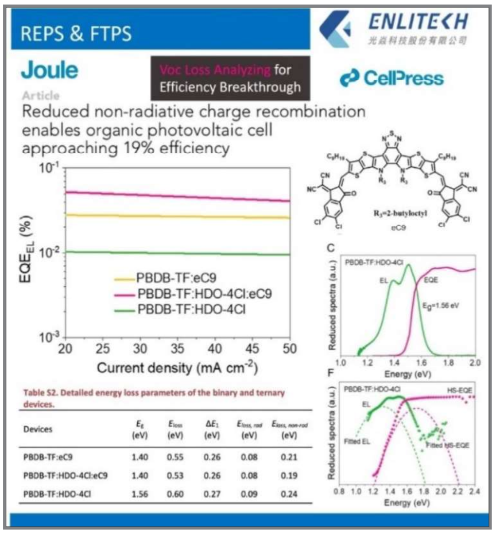
- Trap states, defect states or charge–transfer–state (CTS) .
- CTS fitting through Marcus theory.
- Urbach energy fitting .

Specification / Product Selection Guide

Model	FTPS (PECT-600)
Wavelength Range	1.1~2.07 eV (600nm～1100nm); Option: 0.70 eV～2 eV(600nm～1800nm)
Min. Photocurrent Capability	≤ 100 fA (resolution)
Dynamic Range	≥ 7 orders (>140dB)
Repeatability	>99% (under AM1.5G)
Software	Charge Transfer Energy Fitting, Urbach Energy Calculatuon

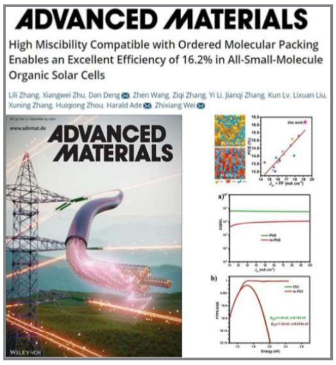
Testing Results / Publications

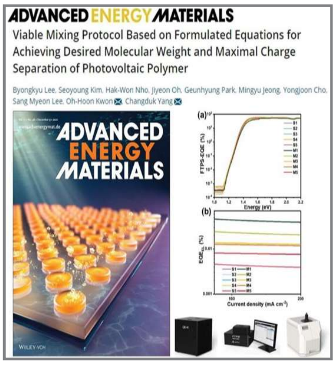
NANKAI UNIVERSITY 1919 · JIANGXI NORMAL UNIVERSITY 1940 · ICCAS · UNIST ULSAN NATIONAL INSTITUTE OF SCIENCE AND TECHNOLOGY

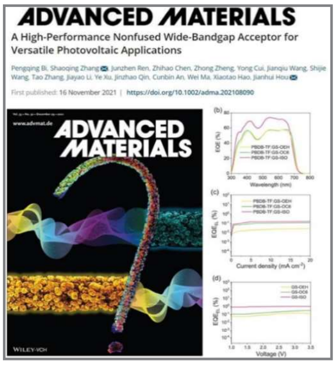


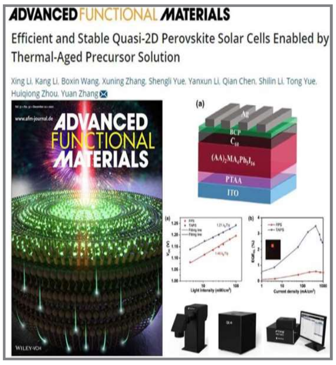
CTS and Voc loss in OPV

In 2021, CellPress' energy flagship journal Joule (Impact Factor 41.248) published the latest breakthrough (~19%) in organic solar cells. An increase in exciton diffusion length (LD) in the acceptor phase was achieved by introducing HDO-4Cl into the PBDB-TF:eC9-based system. In PBDB-TF:eC9-based OPV cells, increased exciton LD can significantly reduce nonradiative charge recombination and improve photon utilization efficiency. The authors not only achieved an excellent power conversion efficiency (PCE) of 18.86%, but also demonstrated the correlation between nonradiative energy loss and exciton behavior using Enlitech's REPS and FTPS high-sensitivity quantum efficiency systems. The results show that tuning exciton behavior is an effective way to reduce non-radiative energy loss and achieve high-efficiency OPV cells.









More Information ▶