Prof Lucimara Stolz Roman

Group coordinator : Nanoestructured devices laboratory

Physics Department- UFPR

Vice Coordinator: Central Laboratory of Nanotechnology (SiSnano)

UFPR
UNIVERSIDADE FEDERAL DO PARANÁ

Clean Energy and Sustainability Symposium: Australia-Brazil – Organic Solar Cells

Regional Universities Network
REGIONAL STRENGTH. NATIONAL SUCCESS.

Australian Government
Department of Education

Sistema Fiep SENAI

PARANÁ
GOVERNO DO ESTADO
SECRETARIA DA CIÊNCIA, TECNOLOGIA E ENSINO SUPERIOR

ARAUCARIA
CIÊNCIA, TECNOLOGIA E INOVAÇÃO PARA O PARANÁ

Federal University of Parana

1912 - Foundation of the UFPR

1967 - First **Master/Doctoral** Program

2004 - the **Patent Office**

2008 - the **Technology Innovation Office**

12 Academic Units with 70 Departments

- Agronomic Sciences
- Applied Social Sciences
- Architecture/Urb & Engineering (Technology)
- Biological Sciences
- Earth Sciences
- Education
- Exact Sciences
- Health Sciences
- Human Sciences, Literature and Linguistics
- Law School
- Oceanic Sciences Research Center
- Professional and Technological Education

107 Undergraduate courses

105 Specialization courses

90 Master / PhD Programs

26,000 undergraduate students

5,500 graduate students

2200 faculty members

3450 staff

Total land: 9.043.913 m^2 **Buildings**: 395.792 m^2

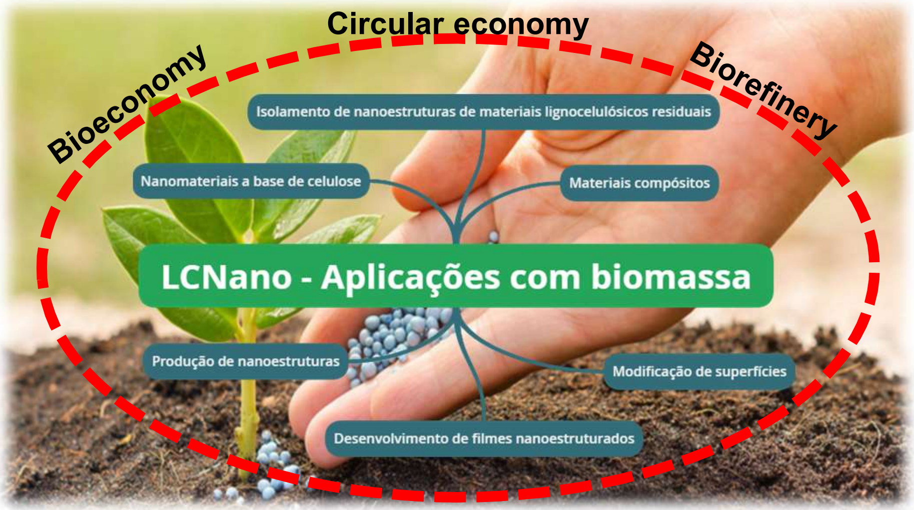
About 1900 Master/PhD titled per year

JARDIM BOTÂNICO
Jardim Botânico de Curitiba
INSTITUTO DE ELETROQUÍMICA
Av. Prefeito Lothário Meissner
LAB MADEIRA
UFPR - Universidade Federal do Paraná - Campus III, Centro Politécnico
LAB QUÍMICA
CME
LAB FÍSICA
CAMPUS POLITÉCNICO

Forestry Technology and Engineering Department - UFPR
Wood Quality and Anatomy Laboratory (LANAQM)
Agroforestry Nanotechnology Group (GNanoAgro)

Profª. Graciela Ines Bolzon de Muniz (gbmunize@ufpr.br),
Profº Pedro H. G. de Cademartori (pedroc@ufpr.br / www.linkedin.com/in/phgcademartori),

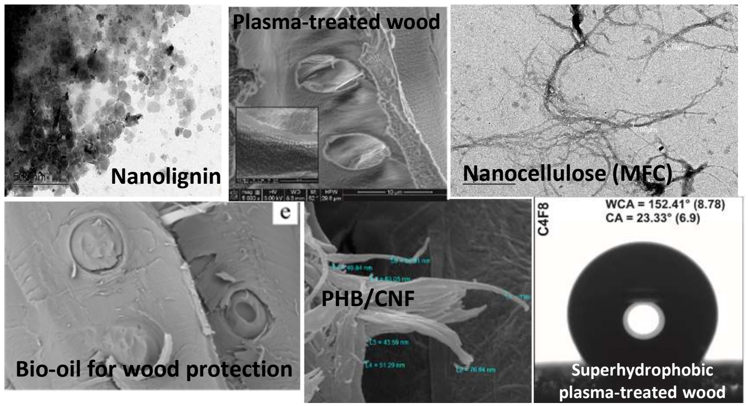
and a multidisciplinary team with more than 20 researchers.



Partnerships with industries, institutes and research networks for prospection of new products based on nanotechnology, biorefinery, circular economy and bioeconomy concepts.

Main research interests

- New products and applications for nanocellulose;
- New products and applications for lignin;
- New products and applications for fast-pyrolysis bio-oil and its derivatives;
- Development of nanocomposites;
- Application of nanostructured biocides;
- Surface modification of lignocellulosic materials.



Luiz Pereira Ramos

Department of Chemistry

Federal University of Paraná (UFPR)

Curitiba, PR, Brazil

www.quimica.ufpr.br/paginas/luiz-ramos

luiz.ramos@ufpr.br

CEPESQ
Química - UFPR

Research Center in Applied Chemistry

LCNano

I. Carbohydrate and lignin chemistry

II. Heterogeneous catalysis for biodiesel production

III. Enzyme-mediated biofuel processes

IV. Microalgae conversion to fuels and chemicals

V. Sugar platform – second generation carbohydrates and carbohydrate derivatives

VI. Multifunctional materials – natural and synthetic layered materials, bionanocomposites (nanocellulose)

VII. Process intensification (SCF, microwave, ultrasound)

VIII. Glycerin and lipid chemistry – plasticizers, polymers, precursors and fine chemicals

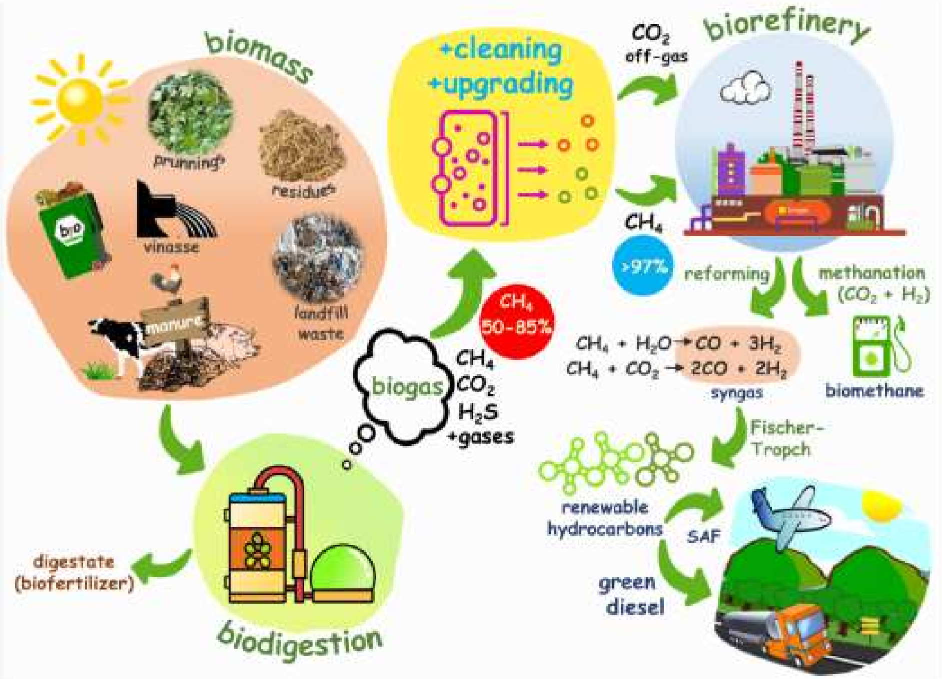
PtX Paraná Project - Energy Transition & Low Carbon Economy in the Paraná's Agribusiness

Objective

To enable a new technological route to produce synthetic sustainable fuels from biogas through the integration of catalytic reforming and Fischer-Tropsch synthesis, with emphasis on developing the Power-to-X market in the State of Paraná.

Project partners

CIBIOGAS ENERGIAS RENOVÁVEIS · UFPR · giz · FUNDAÇÃO ARAUCÁRIA

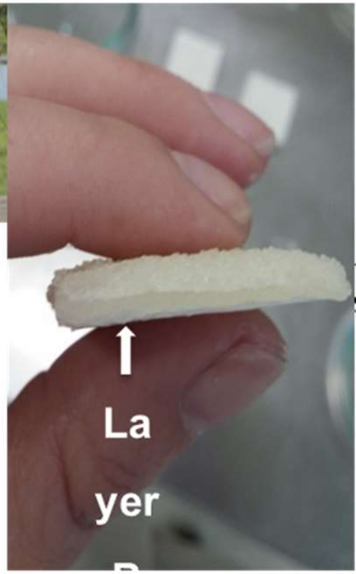


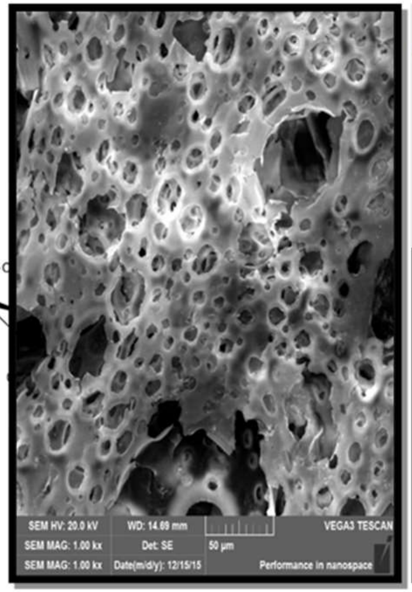
- **Prof. Helton José Alves**
- Dean of Research at Federal University of Parana

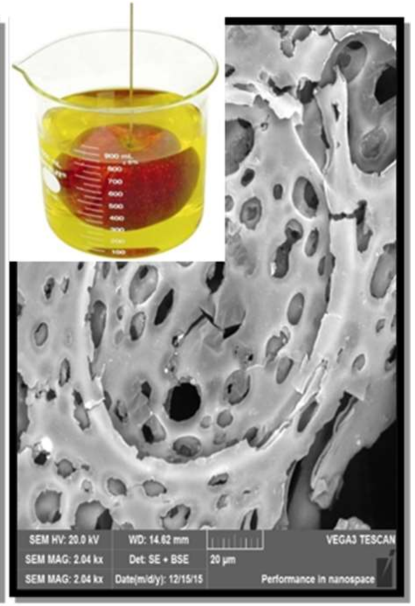
LCNano

Obtaining nanochitosan on a pilot scale and developing products with greater added value.

LABCATPROBIO
LABORATÓRIO DE CATÁLISE E
PRODUÇÃO DE BIOCOMBUSTÍVEIS



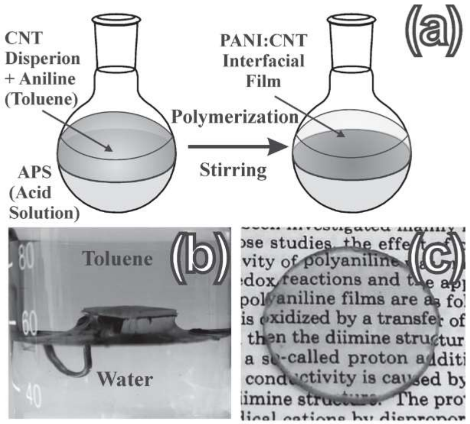


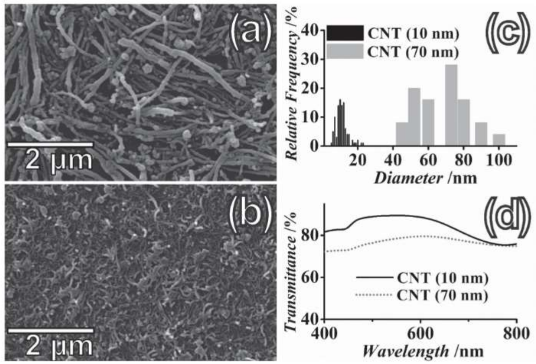


Carbon nanotubes- and graphene-based nanocomposites: preparation, characterization, applications (photovoltaics, sensors, batteries, etc.)

Aldo Zarbin Chemistry department

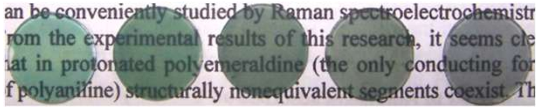
LCNano



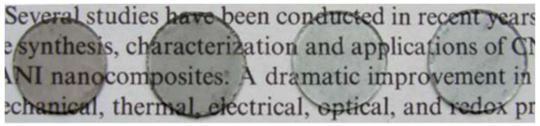


GQM UFPR
Grupo de Química de Materiais

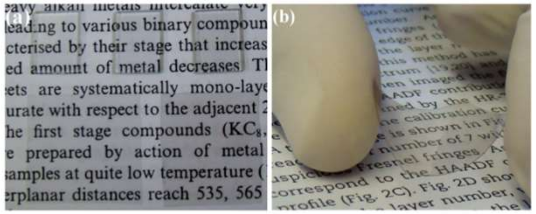
Thin, transparent, conductive films deposited over ordinary substrates



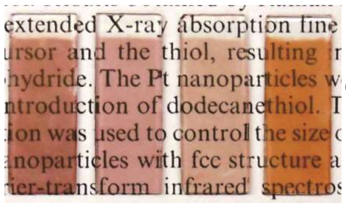
CNTs/polyaniline



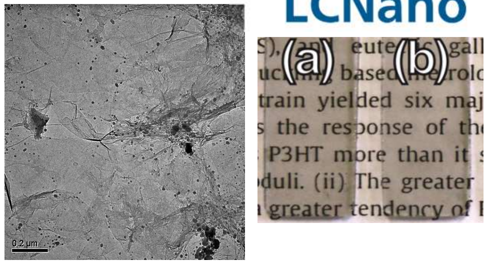
graphene/polyaniline



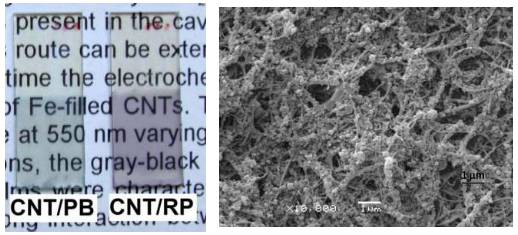
Graphene and tri-layer graphene



CNT/polythiophene



Graphene/Ag nanoparticles – SERS substrates



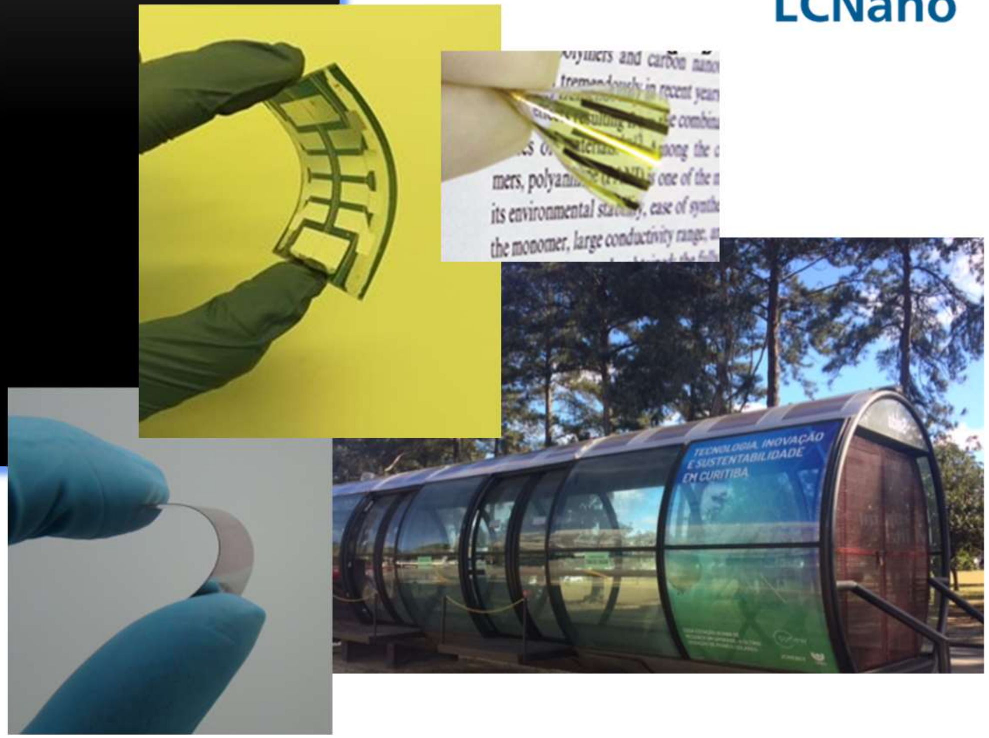
CNT/Prussian blue: sensor; electrochromic device; electrocatalyst

CNT- and graphene/natural Rubber/ structural and multifunctional material

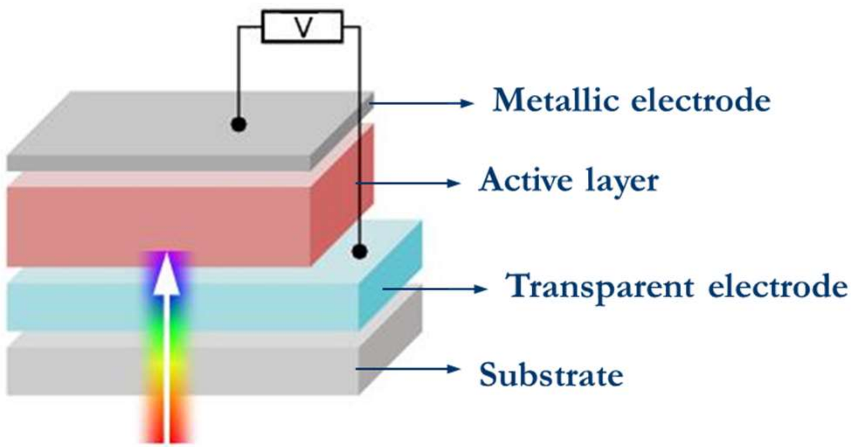
Organic Solar Cells

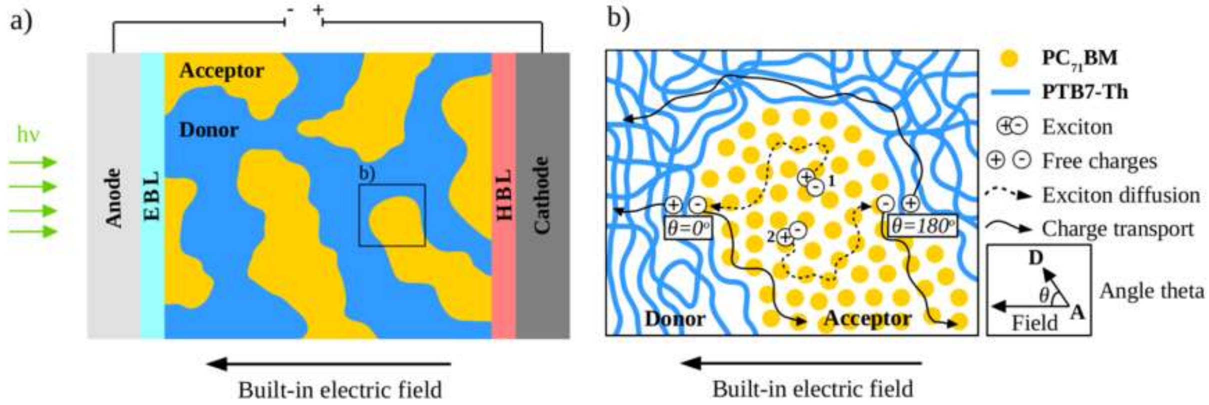
Motivation

Large area devices
Easy processing
Possibly low-cost devices
Flexible devices

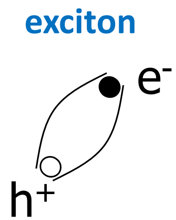


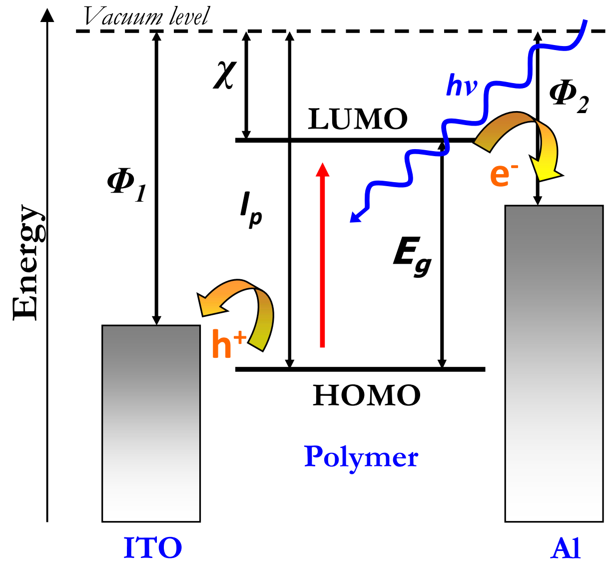
The devices are constructed in a sandwich geometry.
The electrodes must have different work function value to create a built-in potential inside the active layer helping the charge collection.





$$E = \frac{e^2}{4\pi\varepsilon_0 \varepsilon r}$$

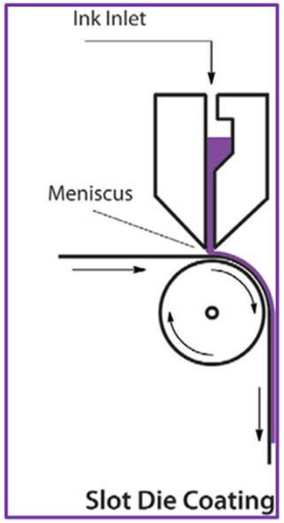


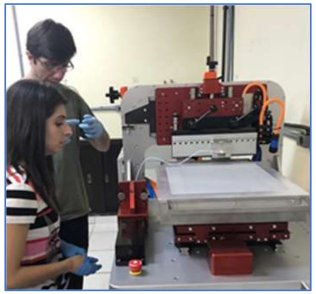


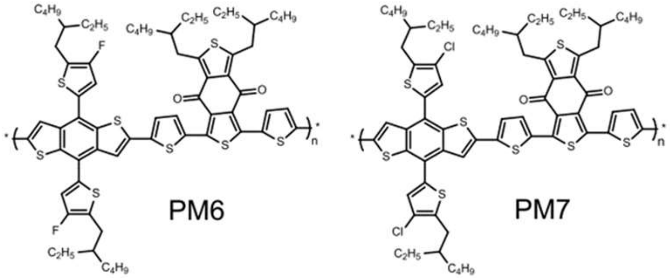
The mechanism of photocurrent generation include basically four processes:
i) light absorption and generation of excited states;
ii) the diffusion of excited states to sites where dissociation of excitons may occur;
iii) dissociation of the excitons to form free charge carriers (at donor acceptor interfaces);
iv) and transport of the carriers by drift and diffusion to the respective electrode for collection.

Kinetic Modeling of the Electric Field Dependent Exciton Quenching at the Donor–Acceptor Interface
L. Benatto, C. A. M. Moraes, M. de Jesus Bassi, L. Wouk, L. S. Roman, and M. Koehler, **J . Phys. Chem. C** 2021, 125, 4436-4448

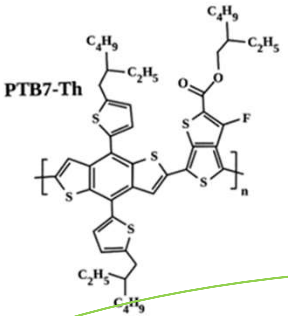
Examples:

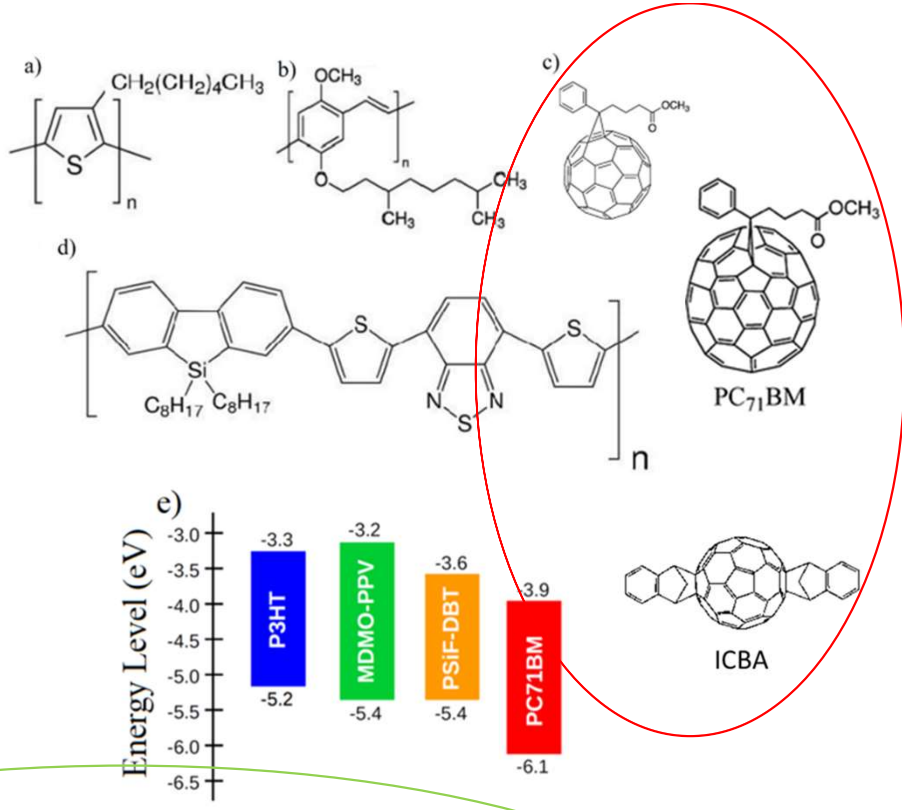


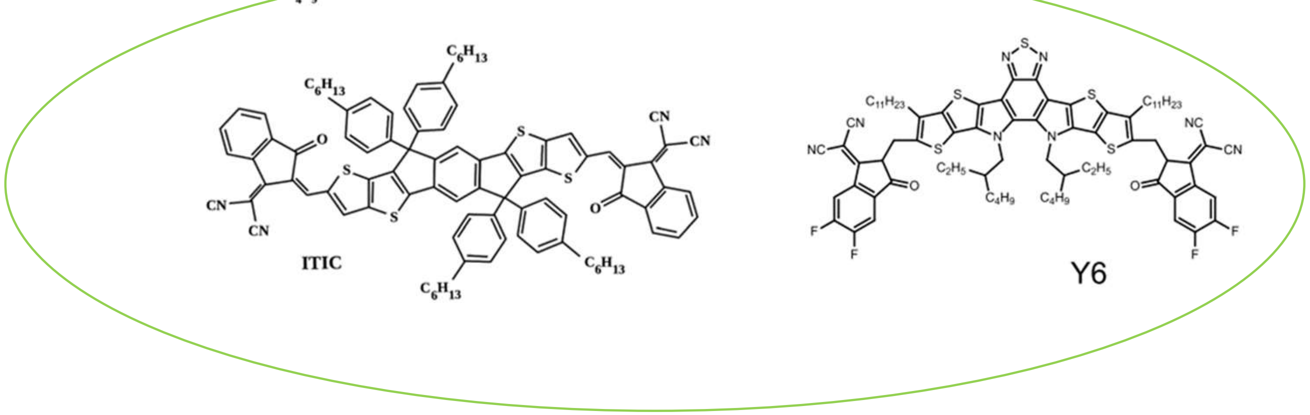




Spin coating deposition



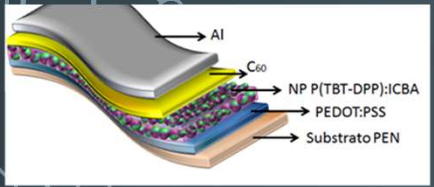


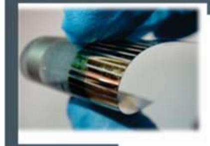


Outline

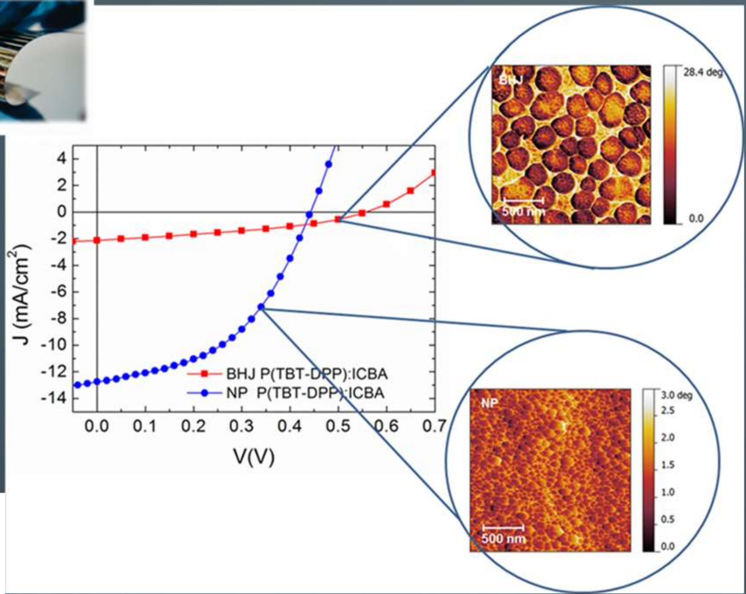
ORGANIC SOLAR CELLS (OSCs):

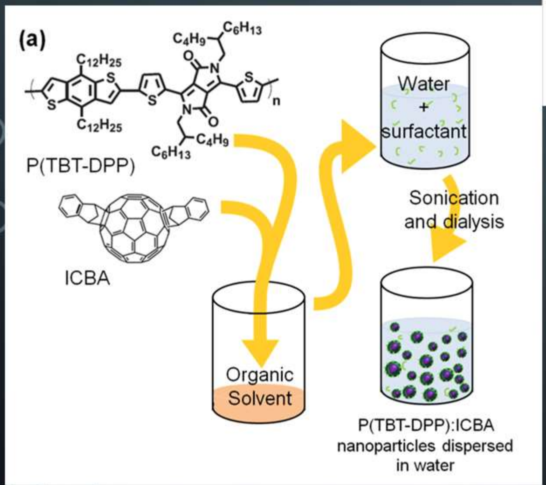
(i) OCSs – Green solvent; Ternary blends, FRET, NPs on water;
(ii) OCSs – improving stability by doping D/A blends;
(iii) OCSs - Studies the case on OCSs lifetime.





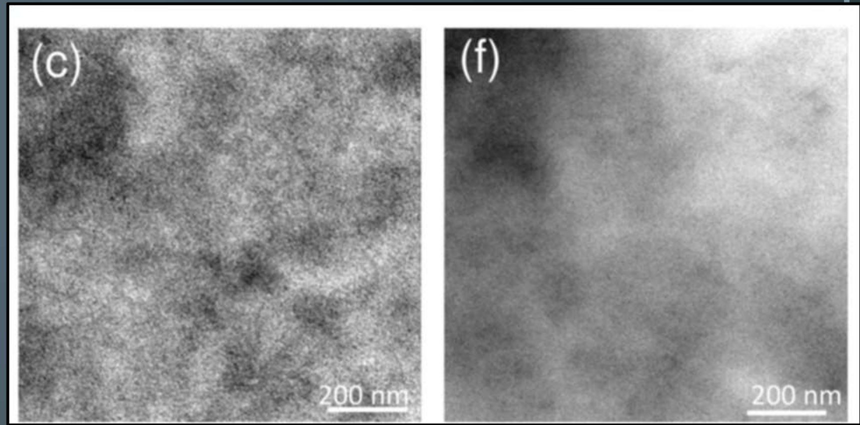
	J_{sc} [mA cm^{-2}]	V_{oc} [V]	FF [%]	PCE [%]
BHJ	2.12	0.55	37	0.44
NP	**12.73**	**0.44**	**47**	**2.63**

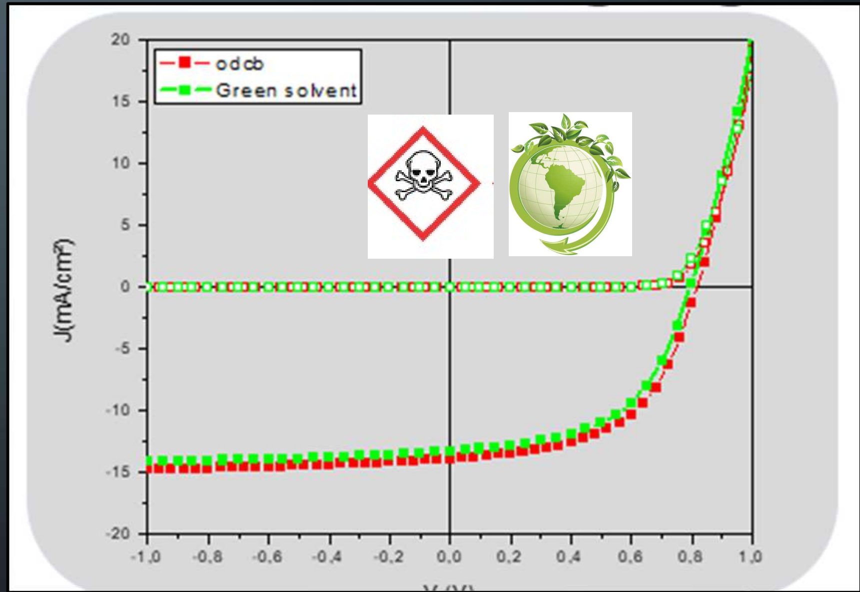


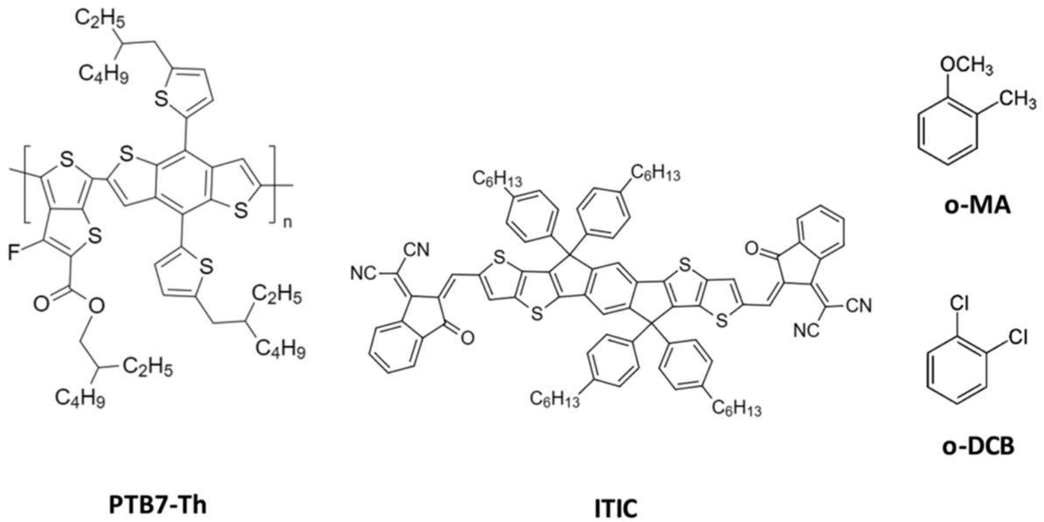


Non Miscible materials

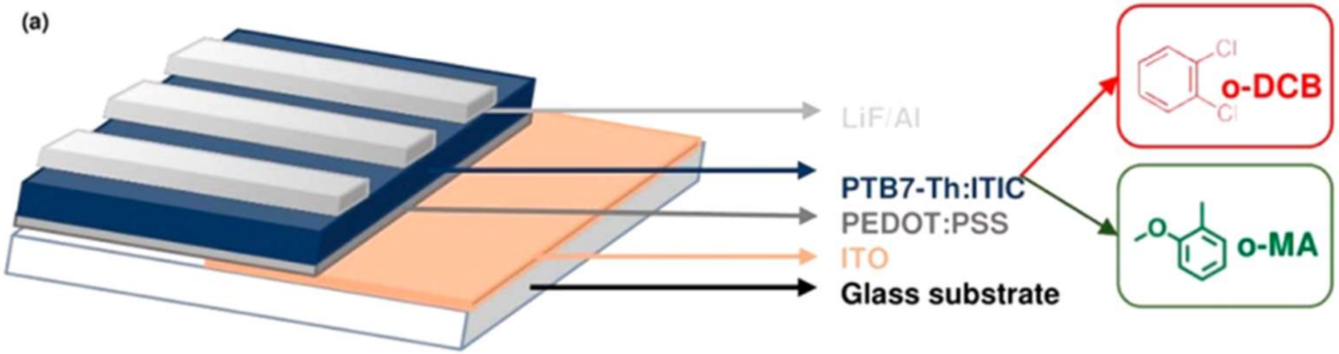
Miscible materials

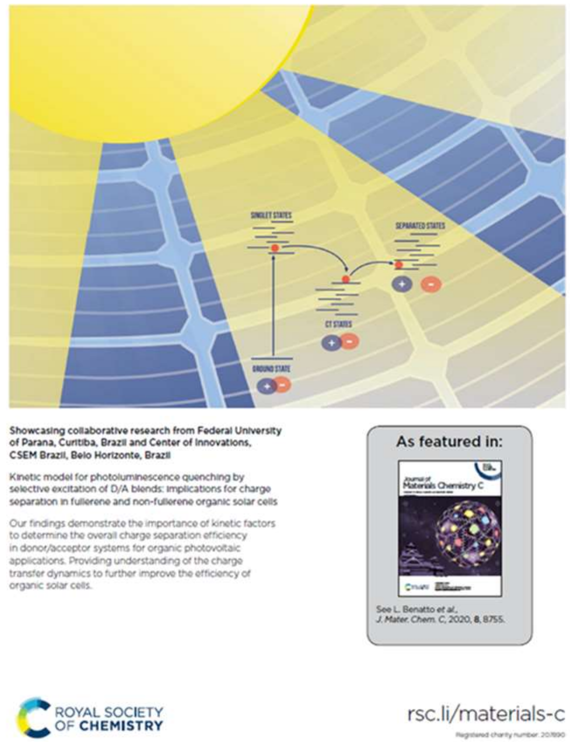






PTB7-Th, ITIC, ortho-methylanisole (o-MA), and ortho-dichlorobenzene (o-DCB) chemical structures.

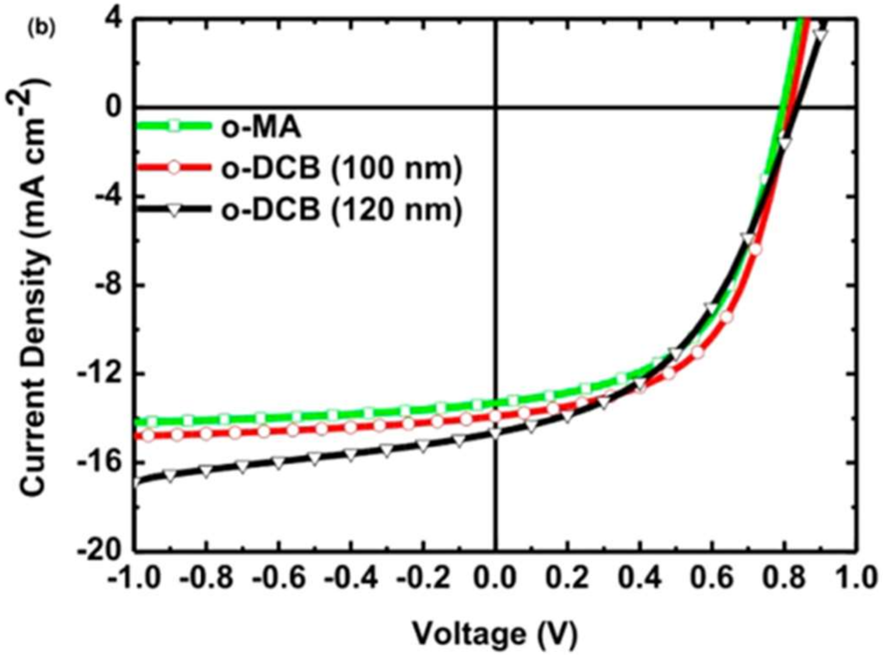




L. Wouk, Y. Jin, L. Benatto, C. Wang, M. Koehler, F. Zhang, LS Roman, ACS Appl. Energy Mater., **2018**, *1* (9), pp 4776–4785

Table 1. Photovoltaic Parameters of the OPVs Based on PTB7-Th:ITIC BHJ, with D:A Ratio of 1:1.3 (Average Values of 20 Devices Are Provided in Parentheses)

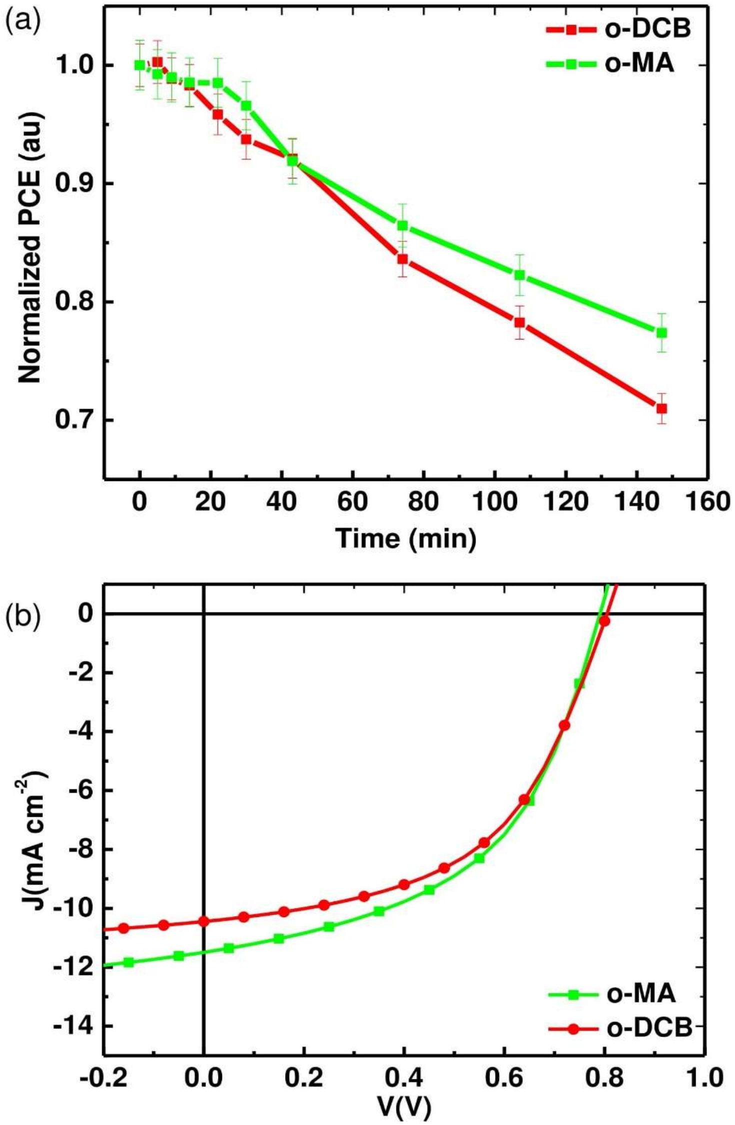
devices	thickness (nm)	J_{sc} (mA cm^{-2})		V_{oc} (V)		FF (%)		PCE (%)	
o-MA	120 ± 5	13.31	13.40 ± 0.40	0.79	0.79 ± 0.01	53.7	52.2 ± 1.0	5.69	5.36 ± 0.30
o-DCB	100 ± 5	13.91	13.71 ± 1.00	0.82	0.82 ± 0.01	54.7	53.7 ± 0.5	6.21	5.90 ± 0.20
o-DCB	120 ± 5	14.65	14.0 ± 1.00	0.83	0.83 ± 0.01	45.7	44.3 ± 1.0	5.58	5.12 ± 0.30



o-Ma (120nm) : Hole mobility = 1.3 × 10−4 cm V−1 s−1
Electron mobility = 8.0 × 10−5 cm V−1 s−1

o-DBC (100nm) : Hole mobility = 7.9 × 10−4 cm V−1 s−1
Electron mobility = 2.4 × 10−5 cmV−1 s−1

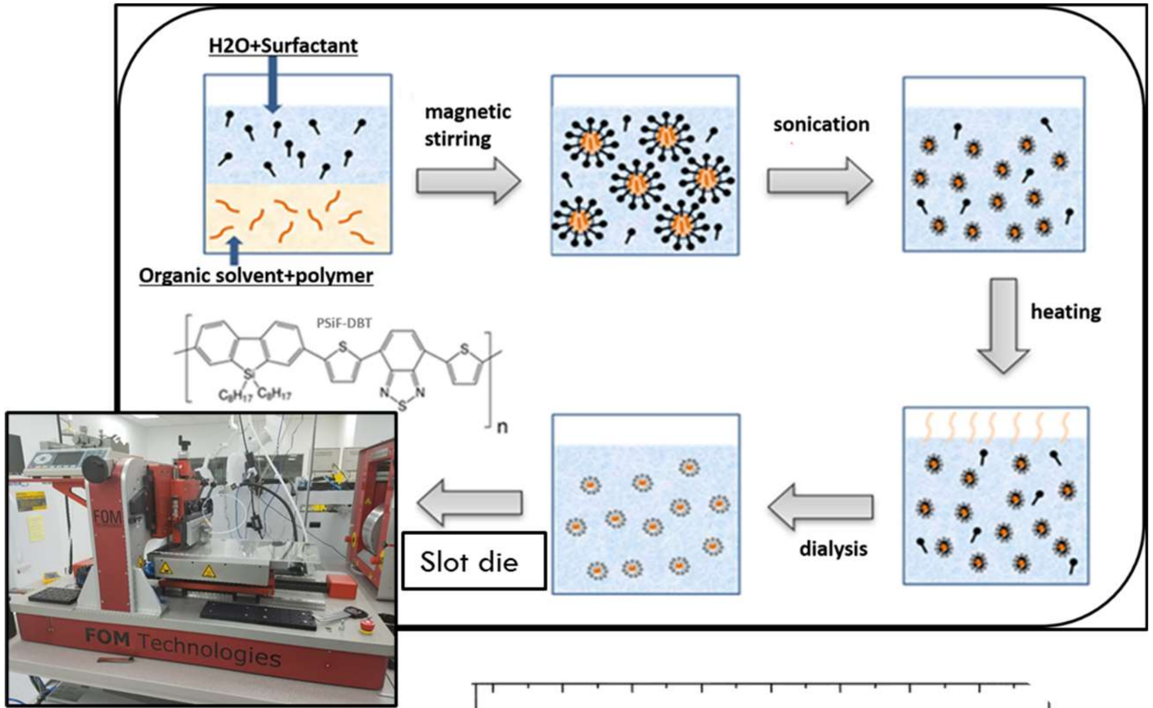
ACS Appl. Energy Mater., **2018**, *1* (9), pp 4776–4785

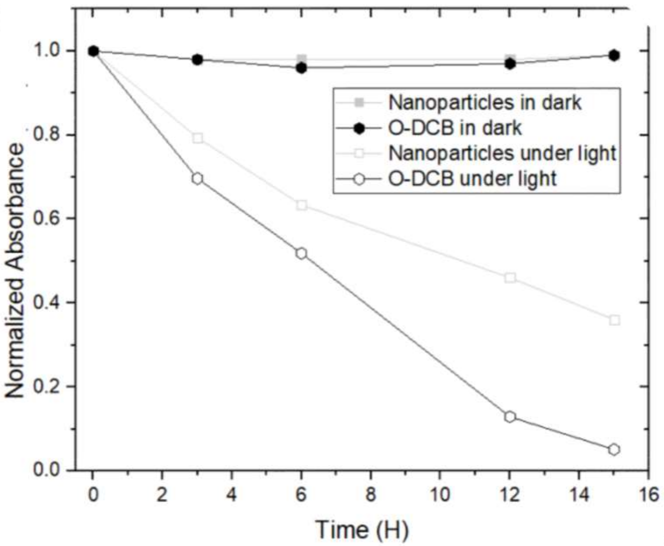


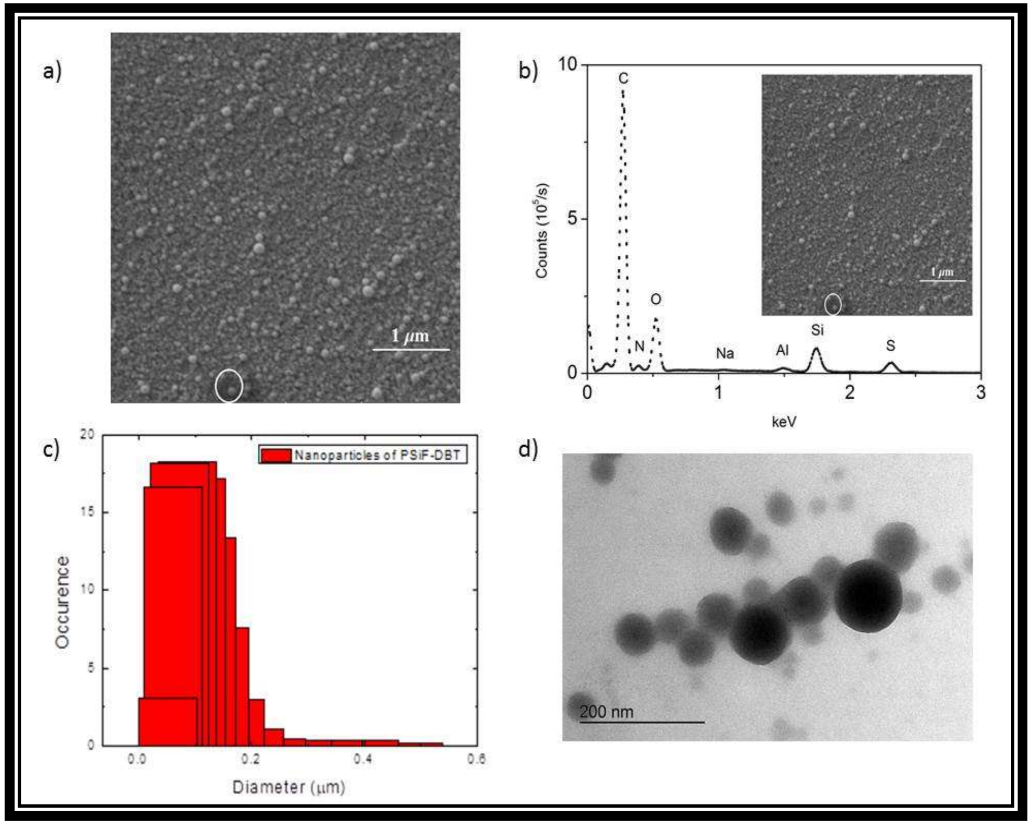
Stability evaluation of the air-tested and air-processed OSC performance composed by PTB7-Th:ITIC (1:1.3) in o-DCB and o-MA. The air-tested devices (a) were made at glovebox and investigated in more than 2 hours in environmental condition. The active layer of the air-processed devices (b) was spin-coated at room condition.

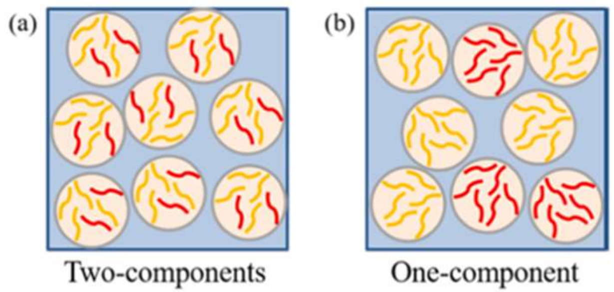
Devices	Thickness (nm)	J_{sc} (mA cm^{-2})		V_{oc} (V)		FF (%)		PCE (%)	
o-MA	120±5	11.49	10.24±1.00	0.79	0.79±0.01	50.2	50.5±0.8	4.57	4.21±0.30
o-DCB	100±5	10.45	10.01±0.40	0.81	0.80±0.01	51.7	51.4±0.2	4.35	4.19±0.10

ACS Appl. Energy Mater., 2018, 1 (9), pp 4776–4785









Ramoni, Wouk, Bassi, Pacheco, Duarte, Rocco, Roman, Thin Solid Films (2021)

Computer Physics Communications 287 (2023) 108715

Contents lists available at ScienceDirect

Computer Physics Communications

journal homepage: www.elsevier.com/locate/cpc

https://nanocalc.org/fret

FRET–Calc: A free software and web server for Förster Resonance Energy Transfer Calculation ☆

Leandro Benatto [a,b,*], Omar Mesquita [a], João L.B. Rosa [b], Lucimara S. Roman [b], Marlus Koehler [b], Rodrigo B. Capaz [a,c], Graziâni Candiotto [a,**]

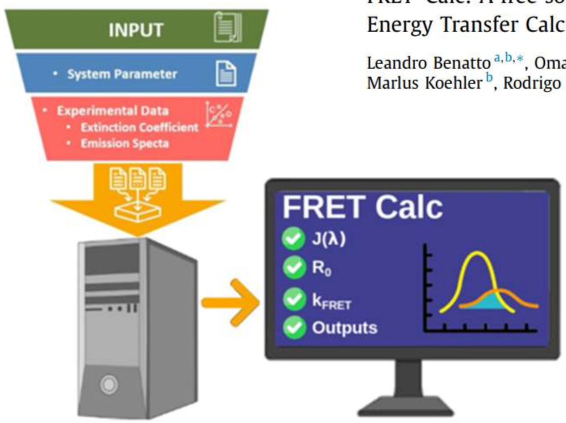
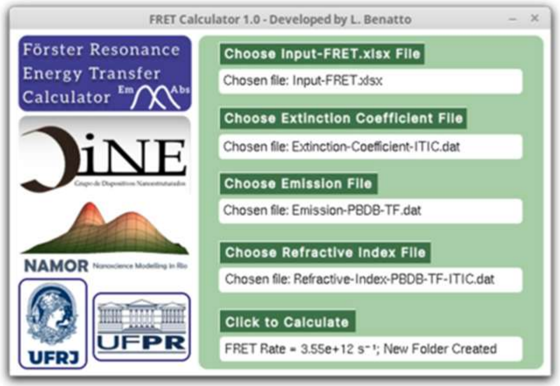
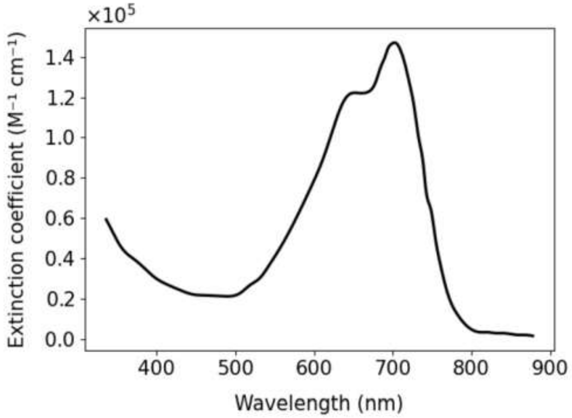
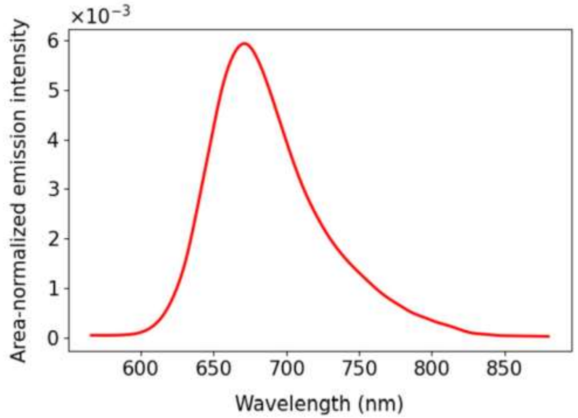
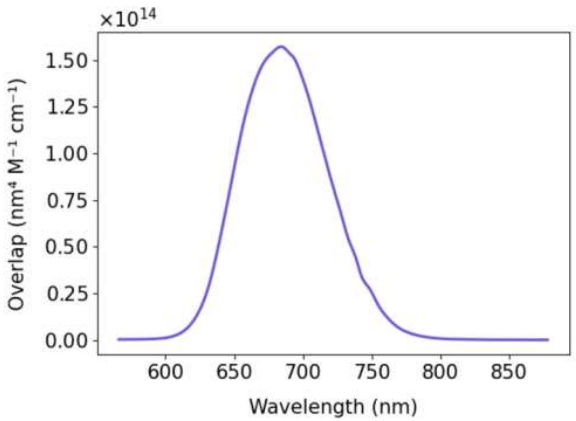


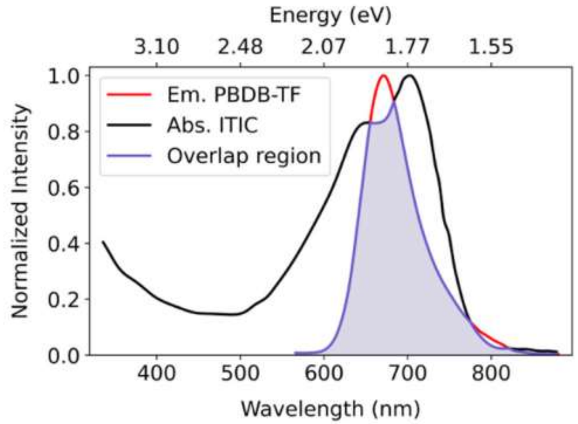
Fig. 1. Graphical representation of FRET–Calc workflow.











Outline

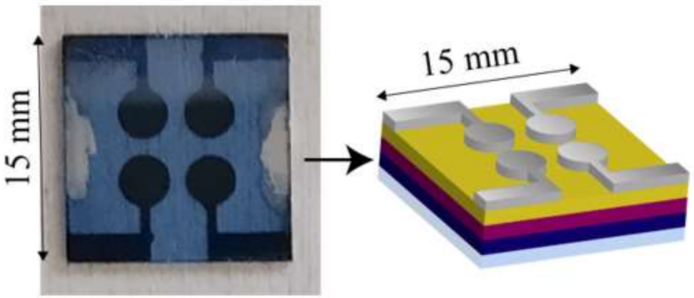
ORGANIC SOLAR CELLS (OSCs):

(i) OCSs – Green solvent; Ternary blends, FRET, NPs on water;

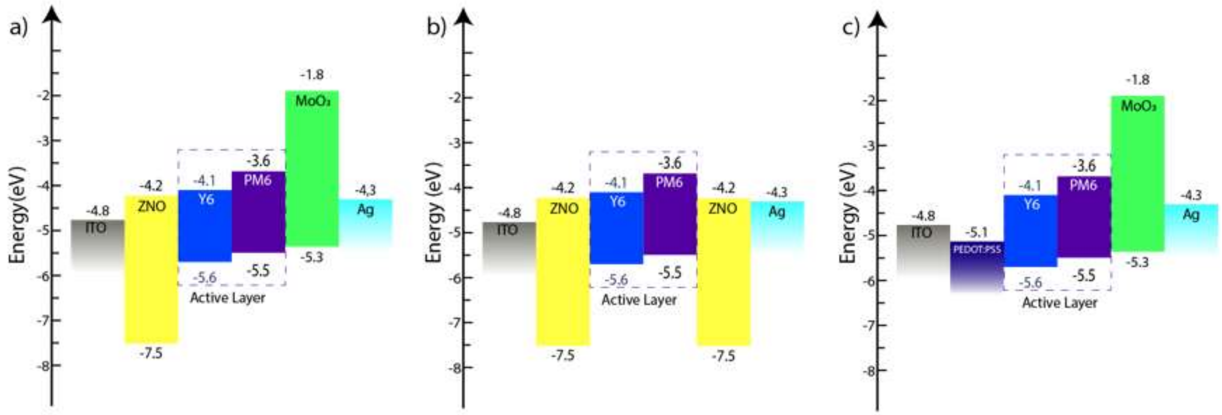
(ii) OCSs – improving stability by doping D/A blends;

(iii) OCSs - Studies the case on OCSs lifetime.

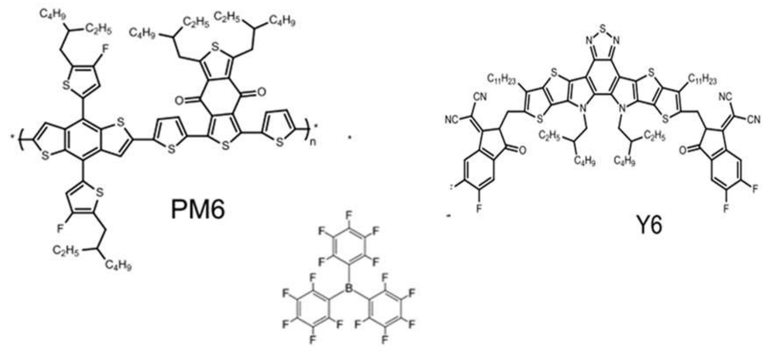
Reduction of OCS degradation through humidity control using BCF in the PM6:Y6 (:1.2) active layer



BCF RATE (%)	PCE (%)		
	Fresh	Aged 5h	Aged 10h
0	14.3±0.2	10±0.2	8±0.1
10	2.5±0.1	-	-
5	4.9±0.1	-	-
3	5.6±0.3	-	-
2	14.6±0.1	12±0.1	10±0.2
1	14±0.2	10±0.1	8±0.2



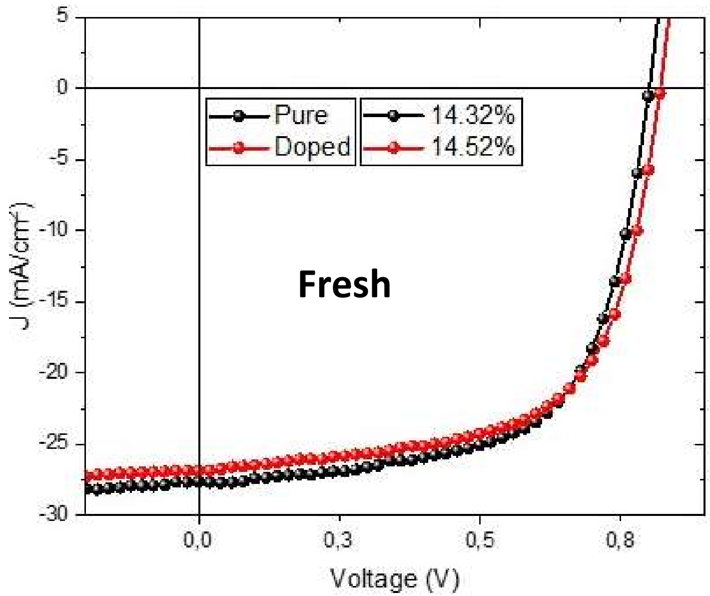
Regular Devices — Electrons only Devices — Hole Only Devices



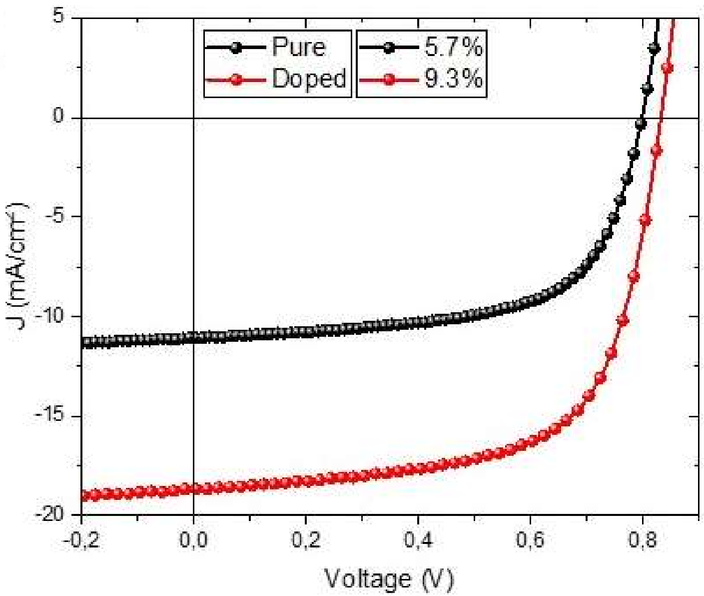
Tris(pentafluorophenyl)borane (BCF)

Pacheco K, M., Araújo J, P, Koehler, M, Madsen, M, Roman, L. S., 2024

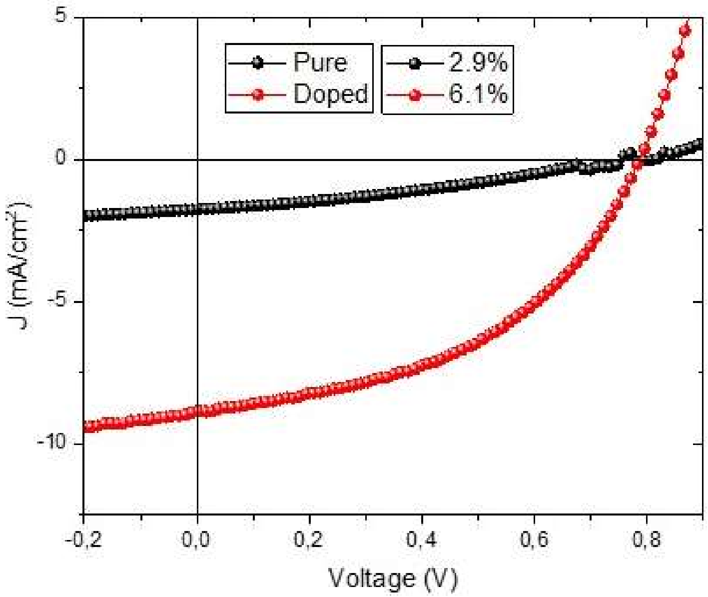
PM6:Y6 with 2% BCF



Aged 10h



Aged 20h



Pacheco K, M., Araújo J, P, Koehler, M, Madsen, M, Roman, L. S., 2024

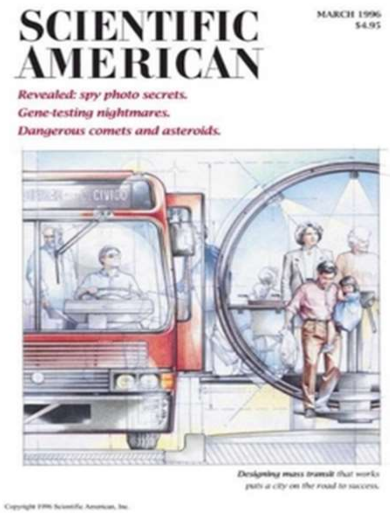
Outline

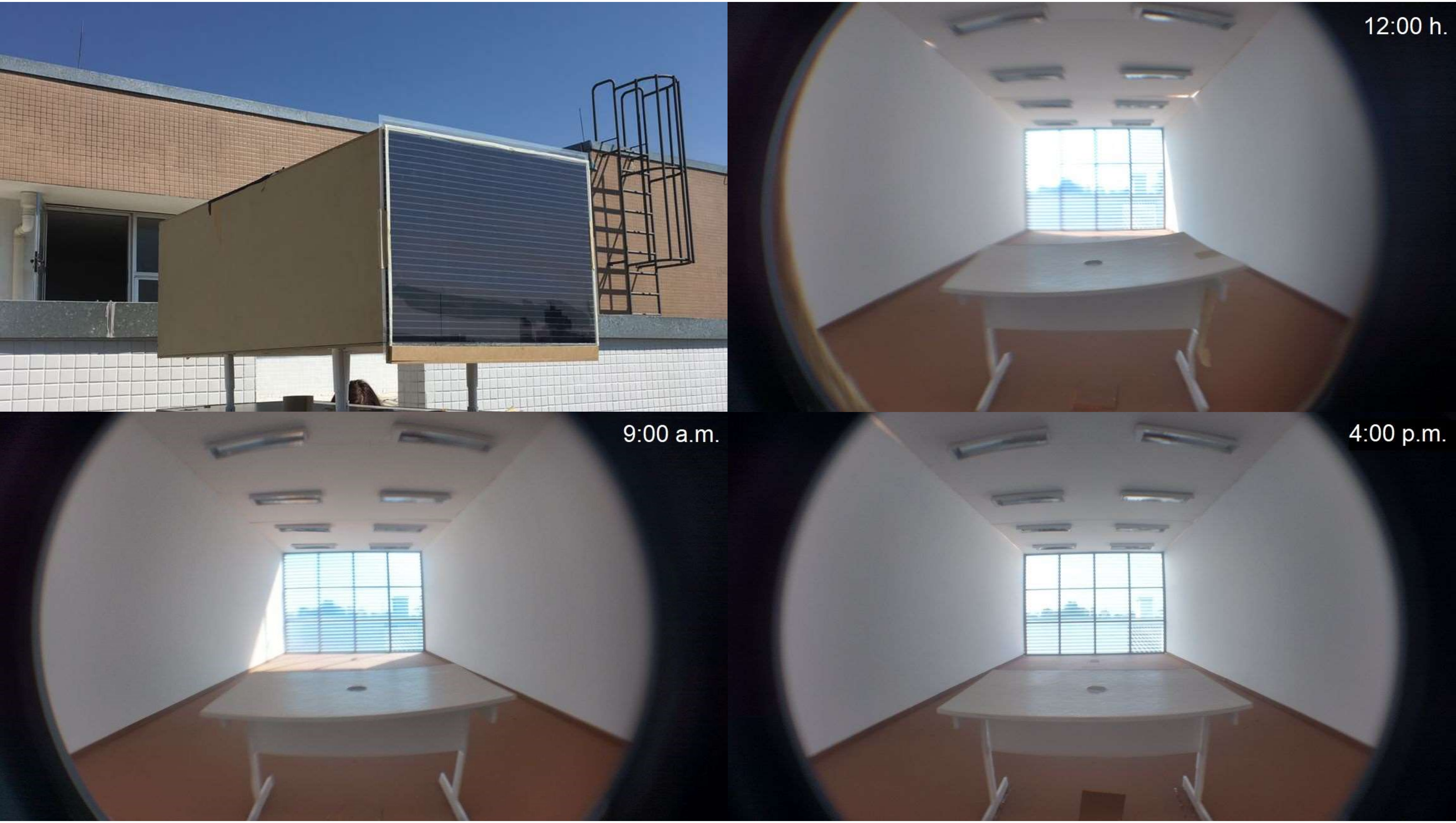
ORGANIC SOLAR CELLS (OSCs):
MORPHOLOGY, LIGHT HARVESTING, EXCITON DISSOCIATION AND ENERGY TRANSFER STUDIES:

(i) OCSs – Green solvent;
(ii) OCSs – improving stability by doping D/A blends;
(iii) OCSs - Ternary blends, FRET;
(iv) OCSs - Studies the case on OCSs lifetime.

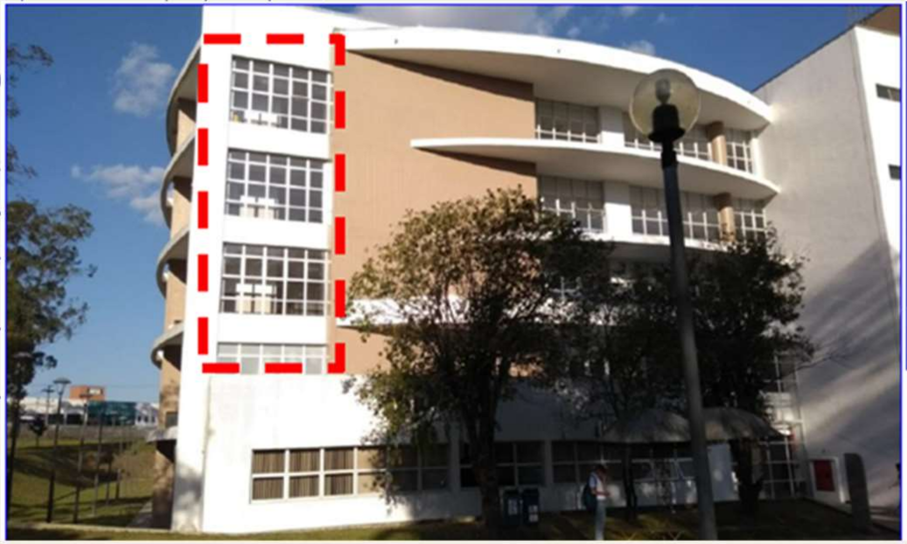
OPVs for windows:

- Insulfim analysis
- OPVs CSEM/SUNEW on bus station “TUBO”.




12:00 h.
9:00 a.m.
4:00 p.m.

COPEL
Pura Energia



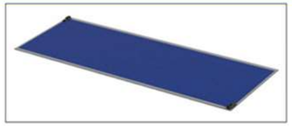


Figura 3 - Painel OPV fixado na folha semirrígida de ACM (imagem ilustrativa).

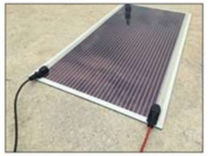


Figura 4 - Painel OPV fixado na folha semirrígida de ACM (imagem real).

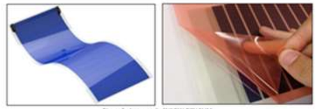
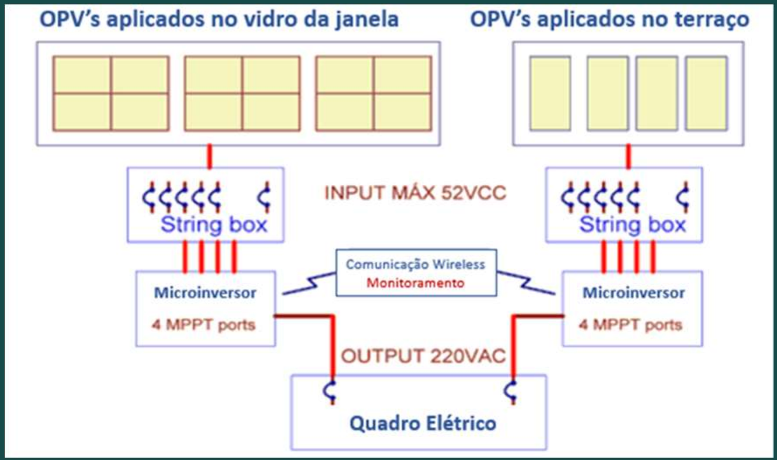
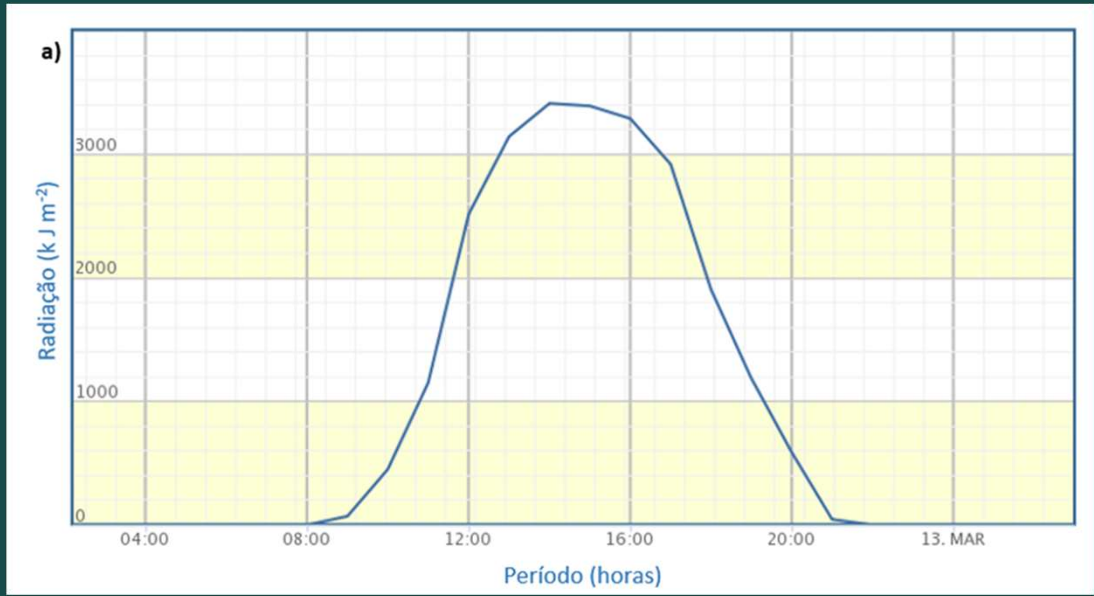
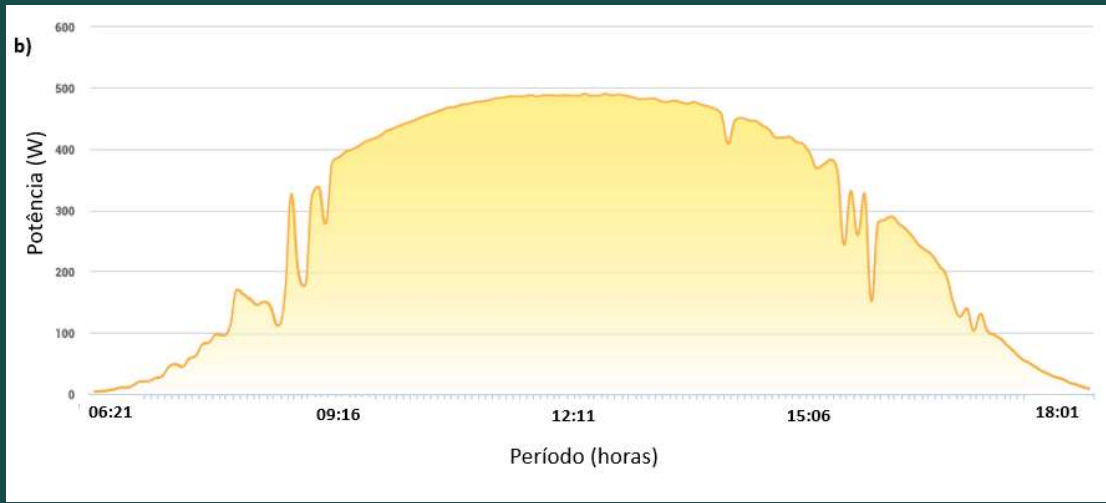


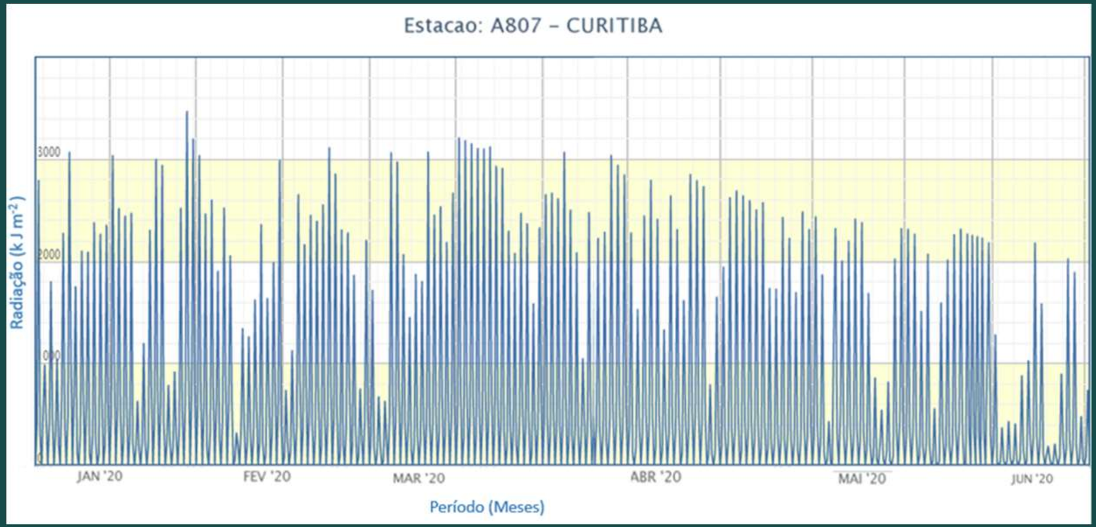
Figura 5 - Imagens do SUNEW OPV SLIM.







a) Radiação Solar e b) potência solar gerada no dia 12 de março de 2020.
b) Fonte: INMET e Microinverter Appsystem ®, respectivamente.


Estacao: A807 - CURITIBA
Radiação (k J m⁻²)
3000
2000
JAN '20
FEV '20
MAR '20
ABR '20
MAI '20
JUN '20
Período (Meses)


9,3 h
26 °C
111,52 KWh
8,8 h
25 °C
85,07 KWh
8,9 h
25 °C
95,8 KWh
7,7 h
22 °C
72,01 KWh
7,5 h
20 °C
55,23 KWh
6 h
18 °C
33,69 KWh
125
100
75
50
25
0
Energia (kWh)
01/2020
02/2020
03/2020
04/2020
05/2020
06/2020
Meses

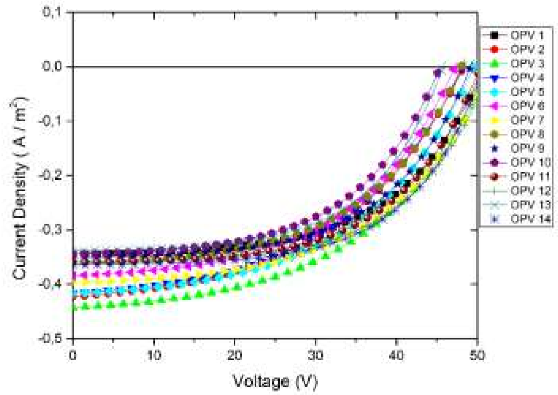
LCNano

SUNEW energy everywhere

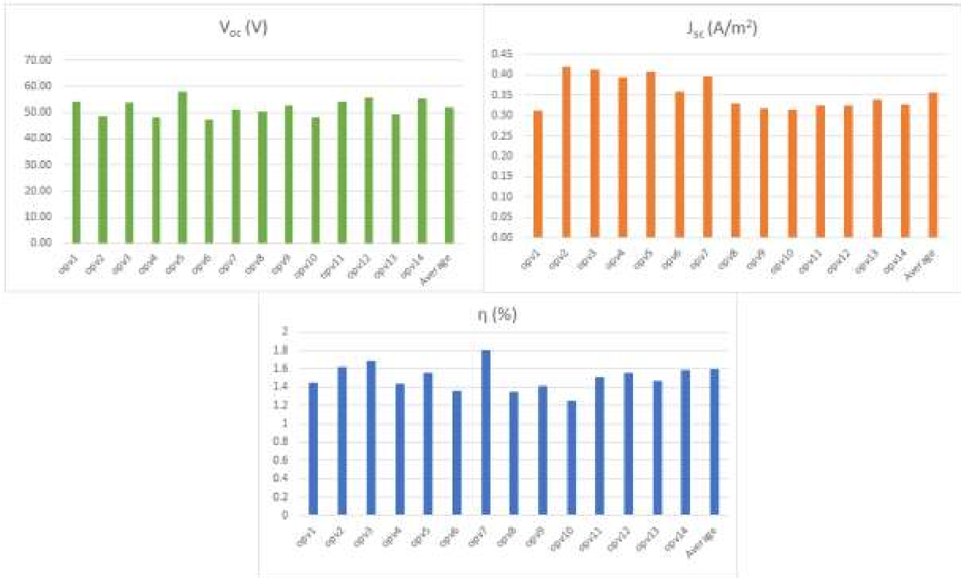
JCHEBLY

URBS

b)



c)



Tempesta, Mariano, Pacheco, Santos, Rocco, Roman, BJP, 52, 2022


iNE
LOCAL
UFPR-Centro Politécnico
Curitiba-PR
ESTAÇÃO DE PESQUISA
TUBO DE ENSAIO
VISITAÇÃO DA ESTAÇÃO PARA DÚVIDAS
SOBRE ENERGIA SOLAR
Toda segunda-feira
das 13h30 às 16h30.
PARA MAIS INFORMAÇÕES
SOBRE A
ESTAÇÃO TUBO
Aplicação do uso de dispositivos fotovoltaicos orgânicos.
Vantagens da energia solar para o meio ambiente.
Física dos fotovoltaicos orgânicos.

Also on top of the “TUBE” station and on the roof:

New Project is coming up:
Let`s see how these encapsulated OPVs work ☺

Acknowledgement:

LCNano

DiNE
Grupo de Dispositivos Nanoestruturados

URBS

CNPq
Conselho Nacional de Desenvolvimento Científico e Tecnológico

https://dineufpr.wixsite.com/dineufpr

Ministério da Ciência, Tecnologia e Inovação
SisNANO
Sistema Nacional de Laboratórios em Nanotecnologias

SUNEW energy everywhere

csem brasil

COPEL

UFPR

inct NanoVida
NANOMATERIAIS PARA A VIDA

CAPES

Finep
INOVAÇÃO E PESQUISA

INCT
Instituto Nacional de Ciência e Tecnologia em Nanomateriais de Carbono

FUNDAÇÃO ARAUCÁRIA