NANOSOLARCELLS

(01/MAY/2022 – 30/APRIL/2025)

EXTENSION GRANTED UNTIL 31/MARCH/2026

“Integration of photonic conversion layers based on photoemissive nano-structured materials for improving sunlight harvesting ability of solar cells”

LEAP-RE

Long-Term Joint EU-AU Research and Innovation Partnership on Renewable Energy

Pillar-1 project

The LEAP-RE project has received funding from the European Union’s Horizon 2020 Research and Innovation Program under Grant Agreement 963530.

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Consortium

Project coordinator:

- Conchi Ania (*aka* Maria Concepcion Ovin Ania), ***CNRS-CEMHTI***, **France**

Project partners:

- Unité de Développement des Equipements Solaires, ***UDES*** (**Algeria**)
- Mansoura University, ***MU-EG*** (**Egypt**)
- Cadi Ayyad University, ***IMED*** (**Morocco**)
- Gheorghe Asachi Technical University of Iaşi, ***TUIASI*** (**Romania**).

Aim of the project

NANOSOLARCELLS aims to increase the efficiency of conventional photovoltaic solar cells by incorporating photonic down-conversion layers based on photoemissive nanostructured materials (carbon nanostructures and polymers). Such photonic layers are capable of harnessing such UV fraction of sunlight and can be easily implemented on existing PV cells. We expect and overall conversion efficiency increase between 2-3%, due to a better exploitation of the solar spectrum.

NANOSOLARCELLS will integrate these materials in electrodes of large dimensions to evaluate the performance in real conditions (outdoor illumination). The materials will be tested for durability in aggressive environmental conditions in African countries.

Relevance vs MARs

*NANOSOLARCELLS focuses on **Topic 1** "Mapping joint research and innovation actions for next-step development of RES and integration of RES in sustainable energy scenarios" of Pillar 1 within PRE-LEAP-RE; **and Topic 3 "Smart standalone systems".** We propose to develop a sustainable and endogenous system for renewable electricity production based on the conversion and efficient harvesting of solar UV photons by means of radiative processes occurring in photoemissive materials.*

The challenge is to integrate theses up-conversion layers in existing solar cells, optimizing the parameters of sustainability, effectiveness, and performance in aggressive environments (e.g., stress imposed by high UV radiation, high temperature, atmospheric pollutants, rain, dust, wind, etc).

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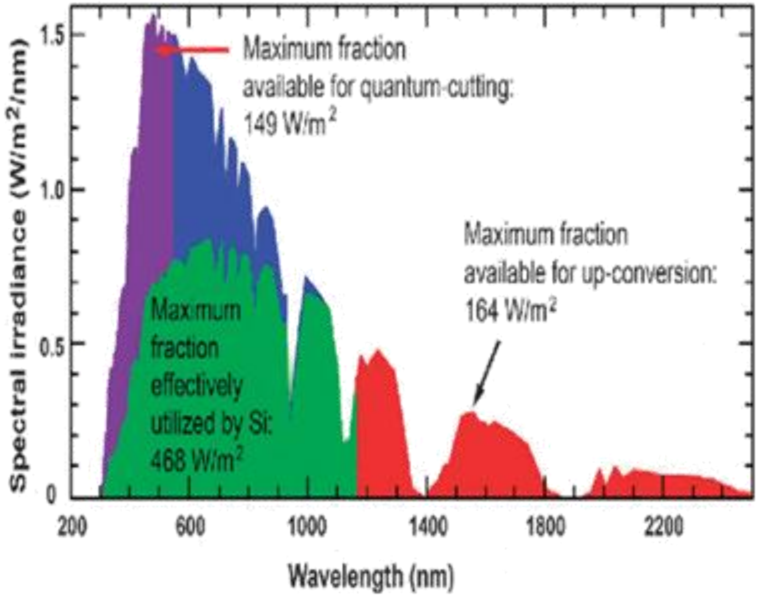
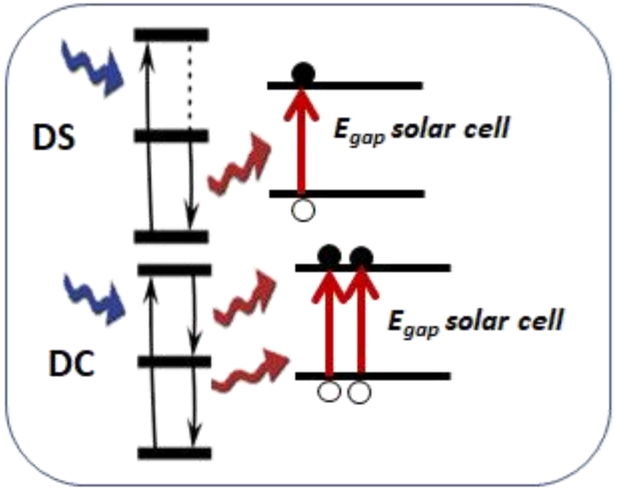
beyond the Shockley-Queisser limit…

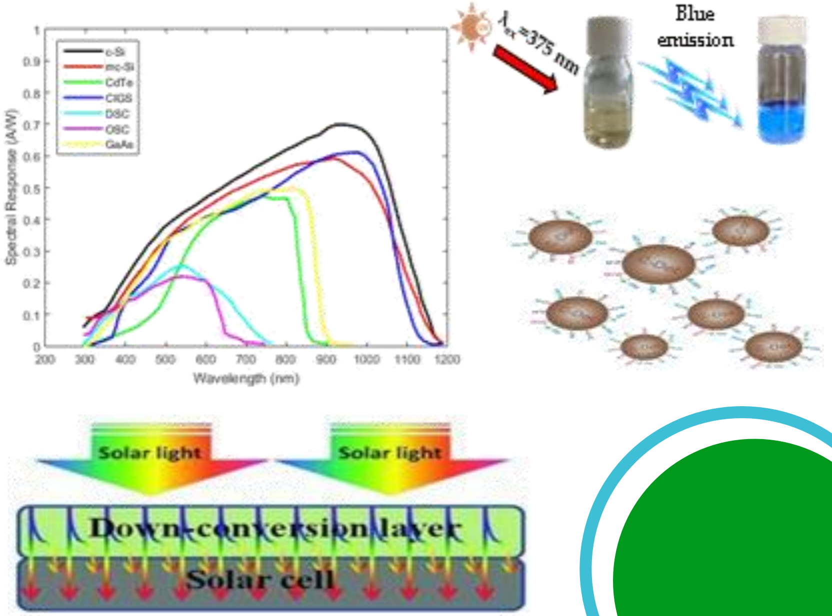
OBJECTIVES

1. Solar UV photonic down-conversion based on photoemissive materials.
2. *Establish the best operative parameters of photonic conversion layers to incorporate them on current layout of commercial solar cells*
3. *Assure low cost of the photonic conversion layers (local precursors)*
4. *Exploring aging mechanisms and durability of devices in aggressive environmental conditions (e.g., dust, high level of irradiation) in African countries.*



Down Shifters / Down Converters





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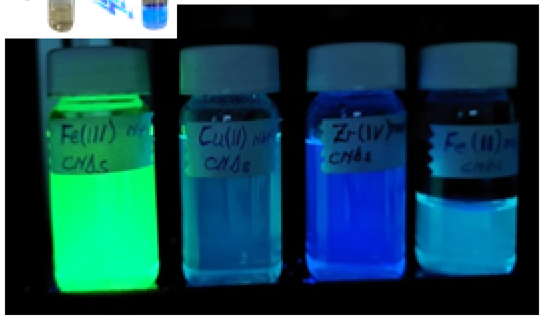
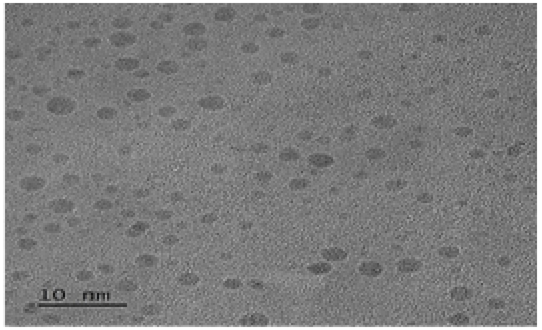
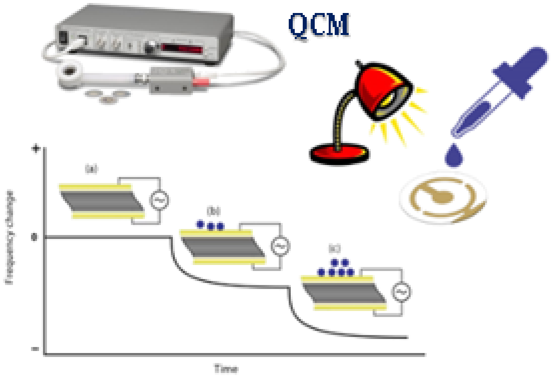
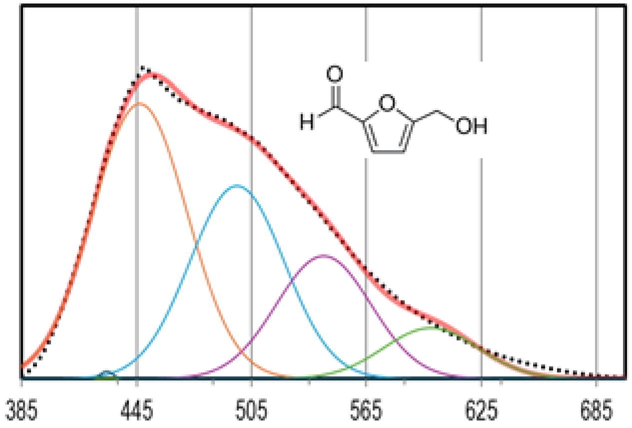
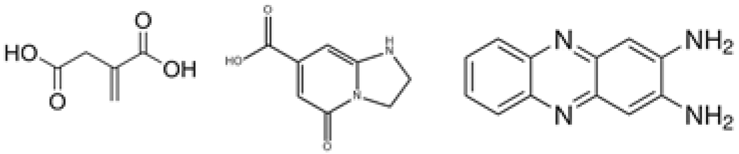
➢ *Results achieved*

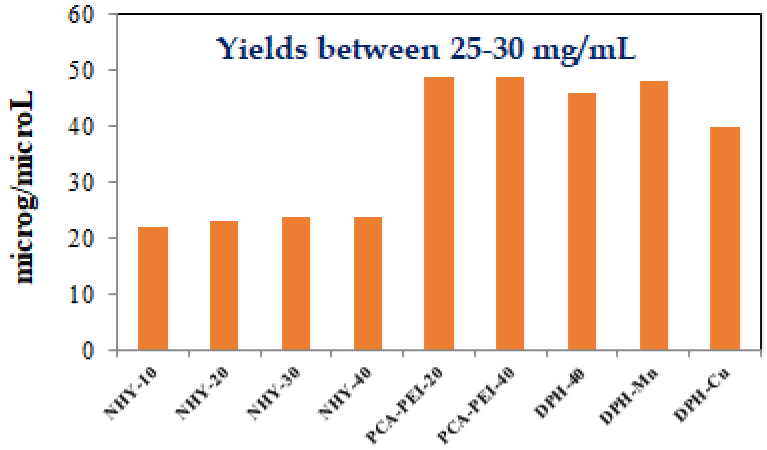


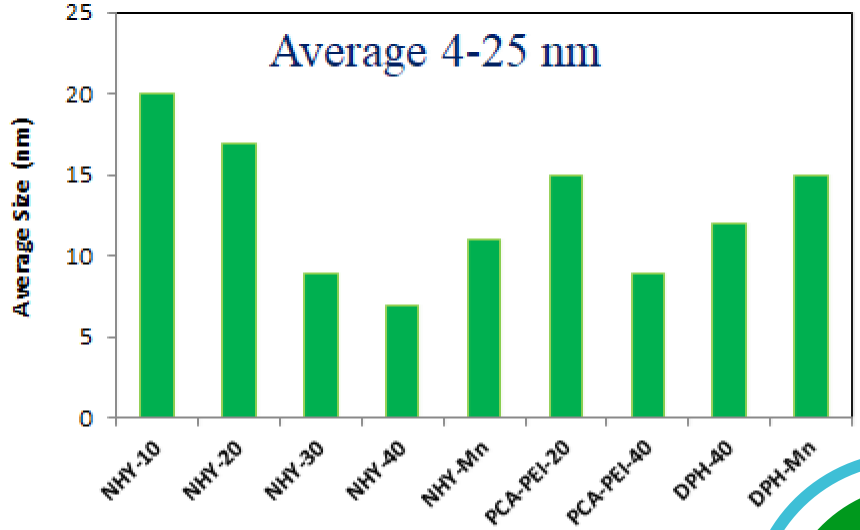












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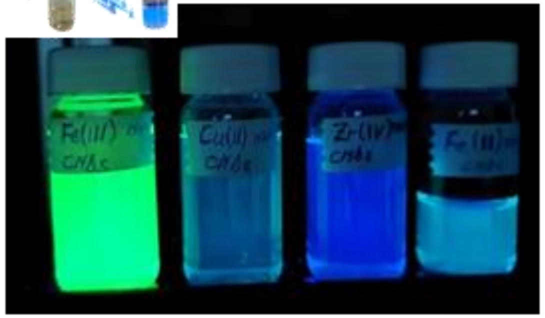
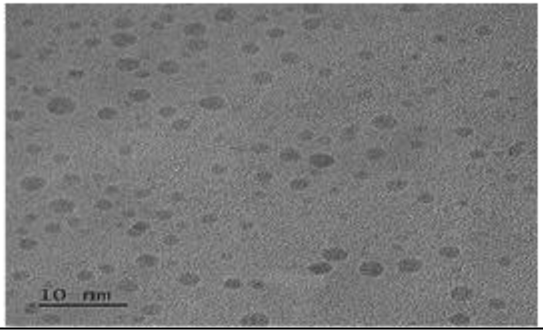
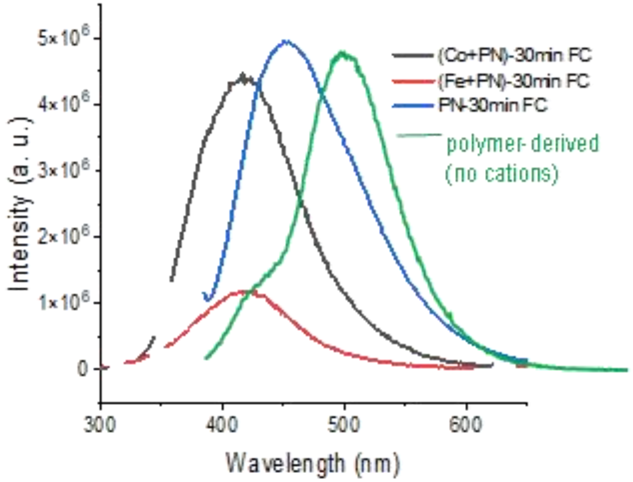
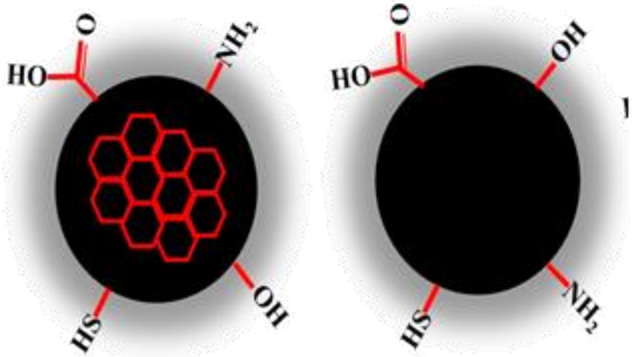
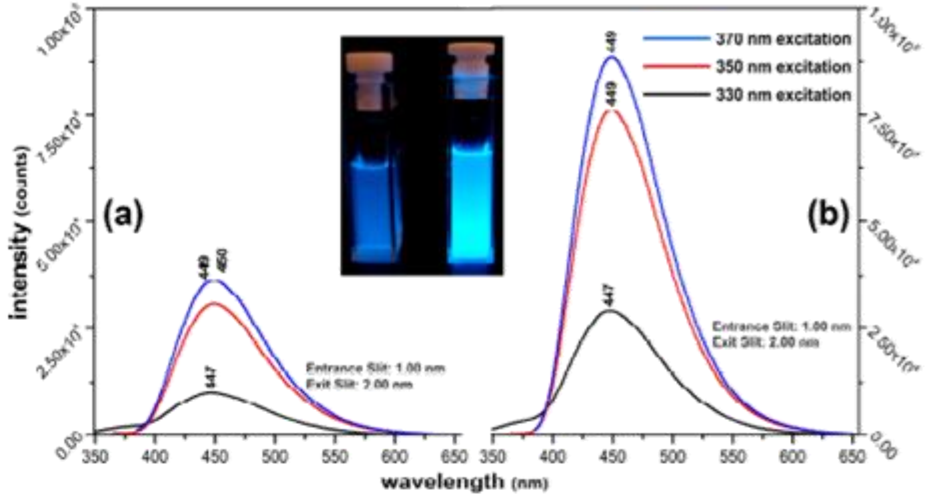
➢ *Results achieved*

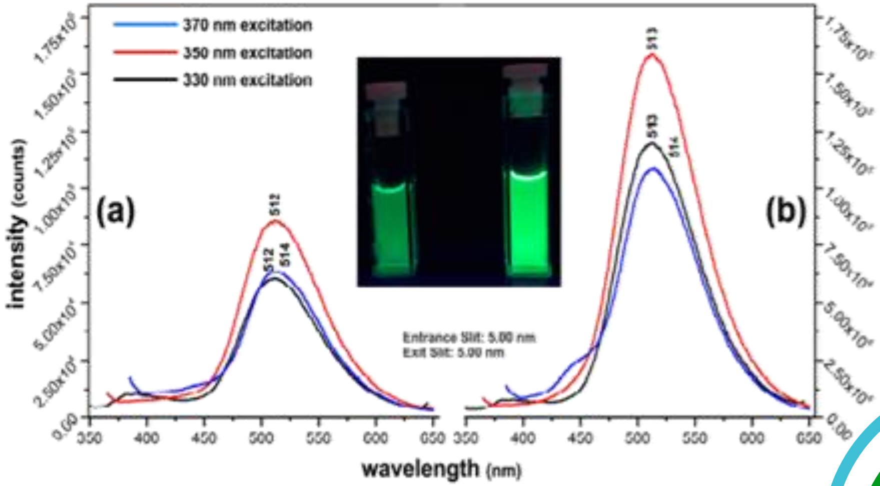












Patent. Preparation method of a photonic conversion medium for improving the efficiency of the photovoltaic solar panels. EPO 24464009.0/EP24464009

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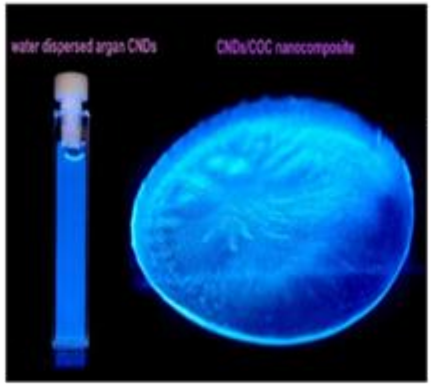
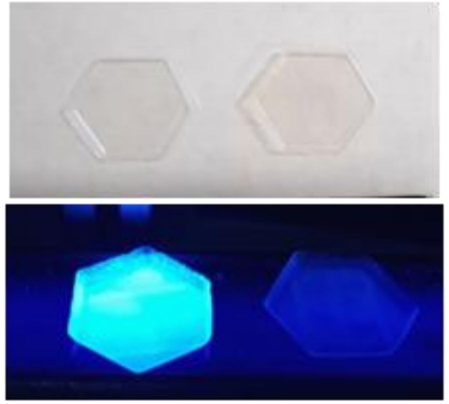
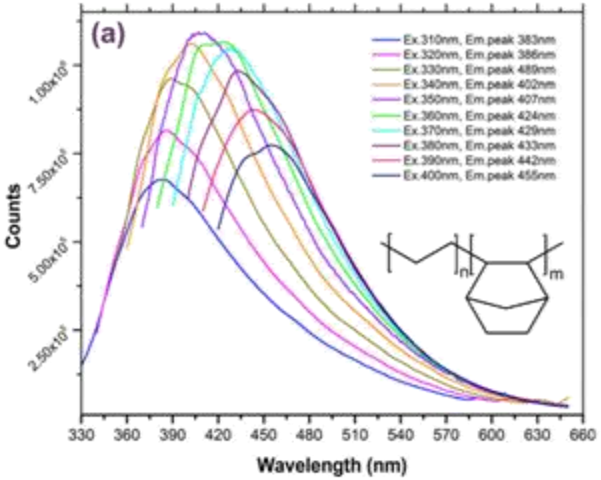
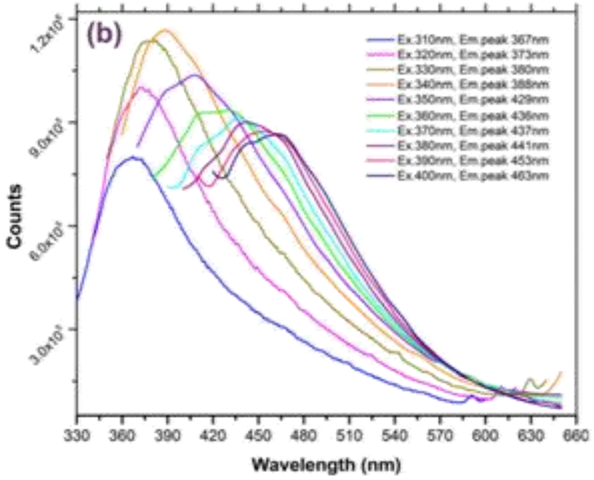
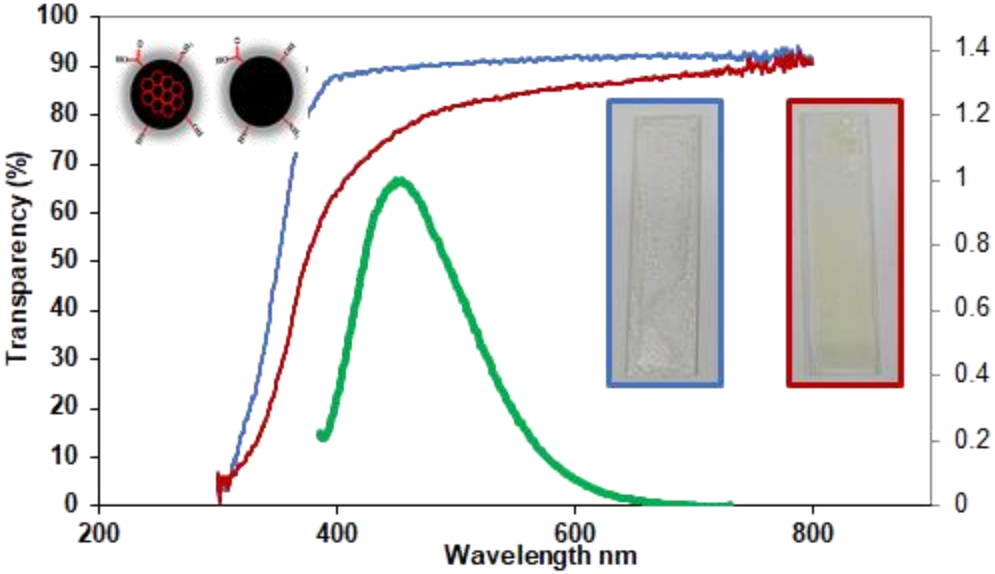
➢ ***Results achieved***

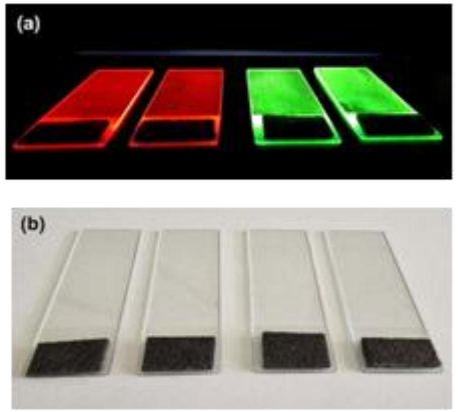


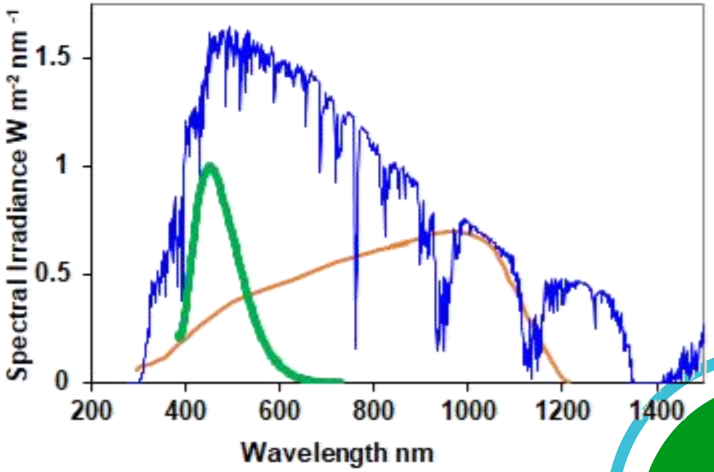












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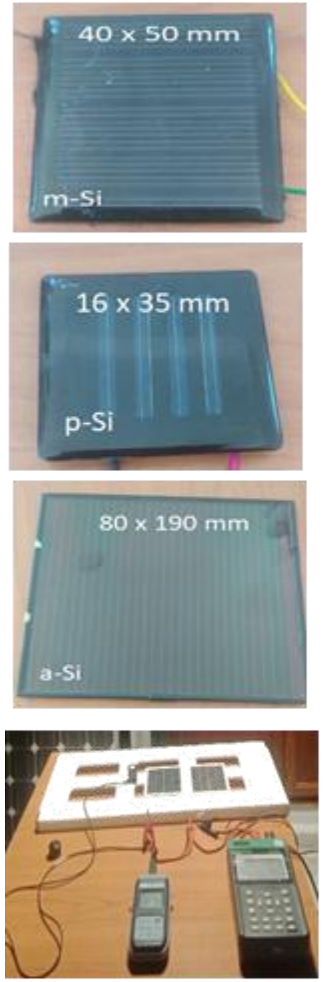
➢ *Results achieved*

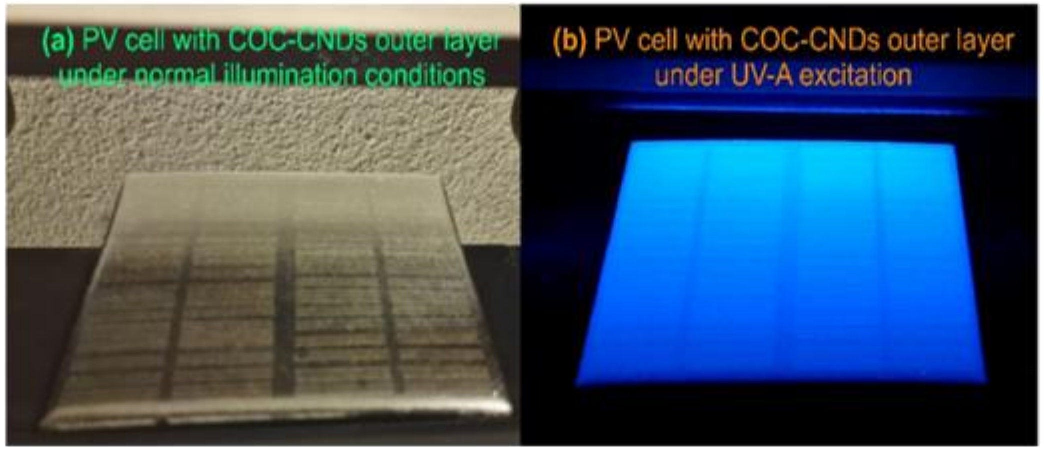


INDOOR

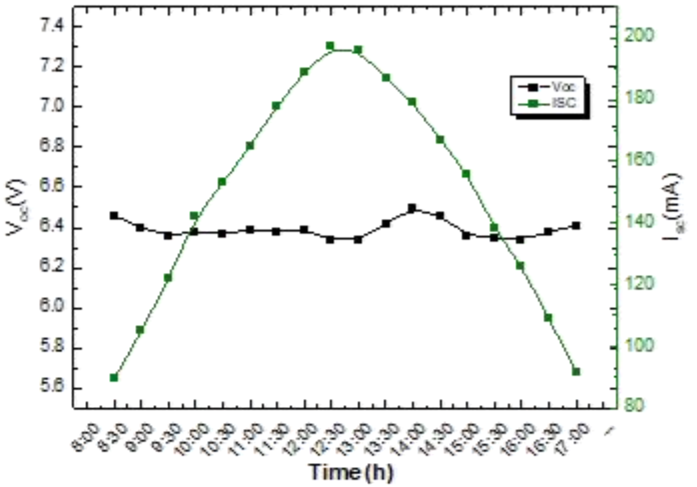
Si-based PV	Irradiance (W/m^2)	V_{oc} (V)	I_{sc} (mA)
raw	595	6.557	92
with photonic layer	595	6.598	94.7

+ 2.9%

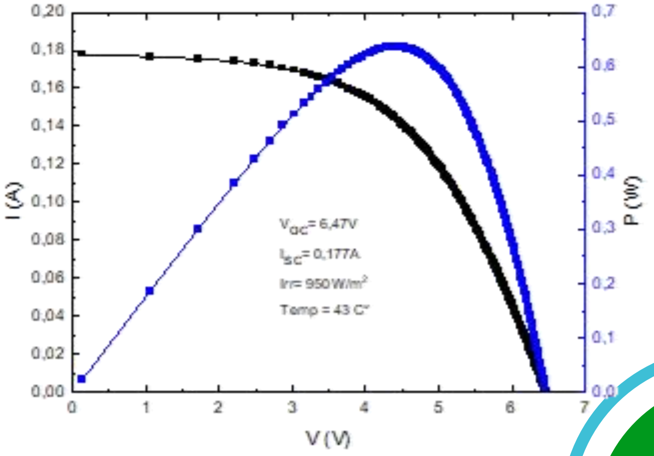
The PV cell output (LED 5 mW/cm^2) increased from 10.62 V to 11.14 V after the incorporation of the COC–CND conversion layer.



OUTDOOR



(long term exposure tests ongoing)



Solar Energy (under revision)

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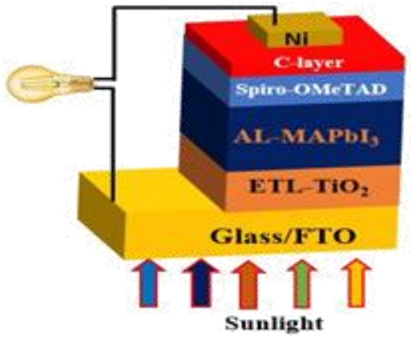
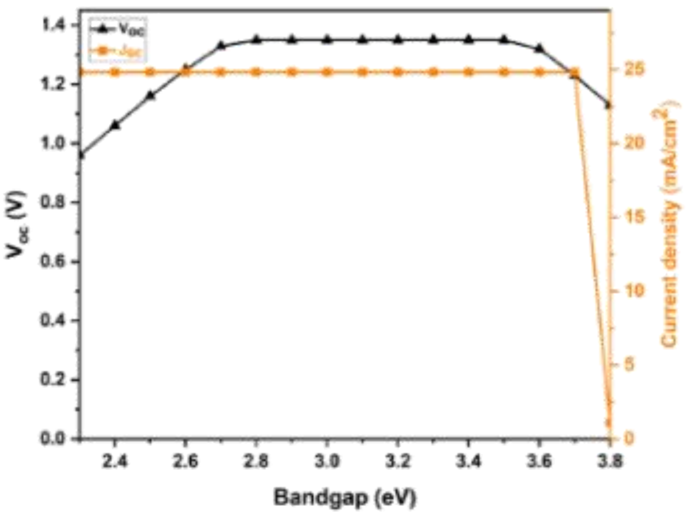
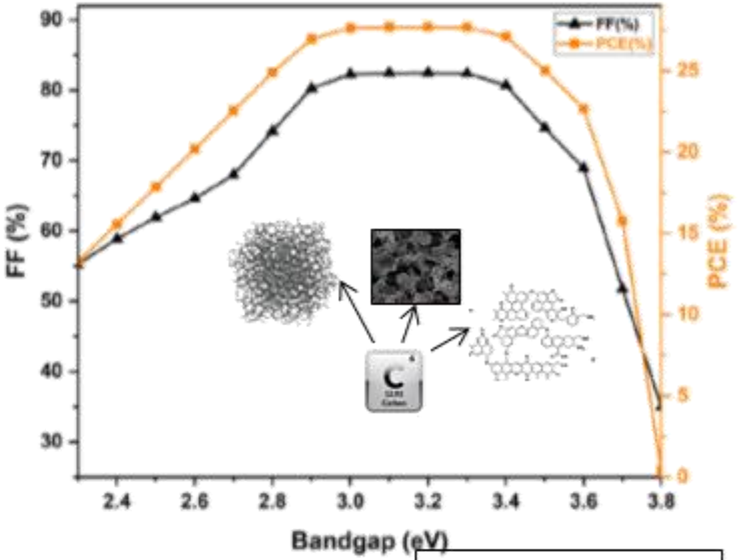
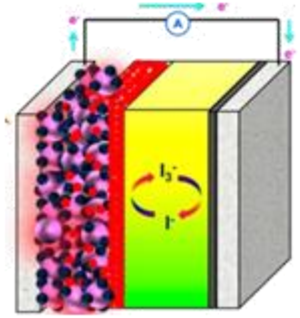
➢ *Results achieved*

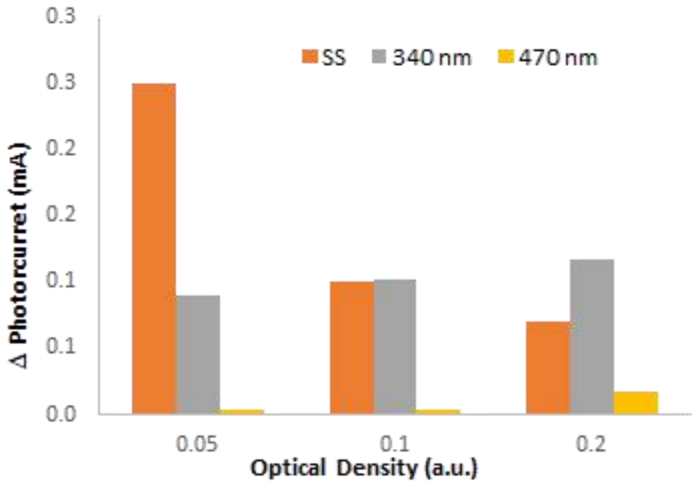


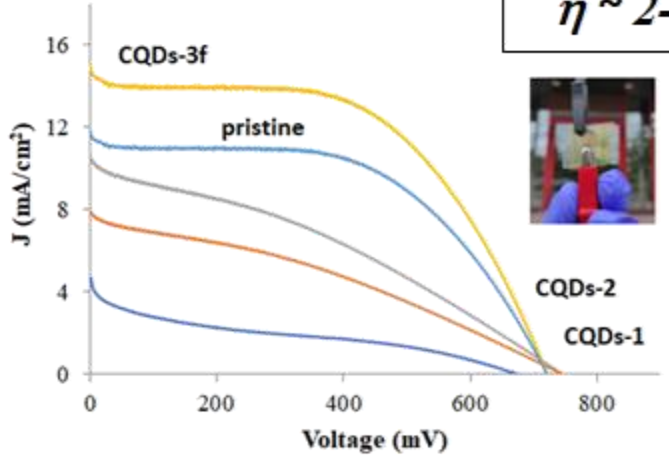




η ~ 2-8 %







Adv. Theory & Sim. (2024) 2400771

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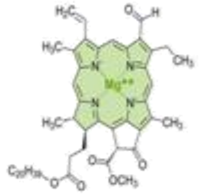
LEAP-RE

➢ *New pathways, collaborations & opportunities for funding applications*

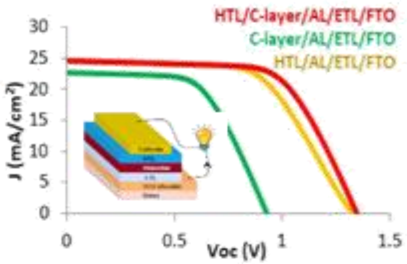
PASET
Partnership for Skills in Applied Sciences, Engineering & Technology

(2023-2026). Additive-assisted fabrication of efficiency and stable perovskite solar cells (natural products and carbon-based additives), Moi Univ. Kenya, RSIF/JIRA/003



UNIVERSITY of the WESTERN CAPE

(2024-2027). Joint PhD thesis between Univ. Western Cape (South Africa) and CNRS/Univ. Orléans on "Tandem photovoltaic devices formed with perovskite on high-efficient silicon cells". Prof. Emmanuel Iwuoha, South African Research Chair for NanoElectrochemistry & Sensor Technology.



LEAP-SE
Long-Term Joint EU-AU Research and Innovation Partnership on Sustainable Energy

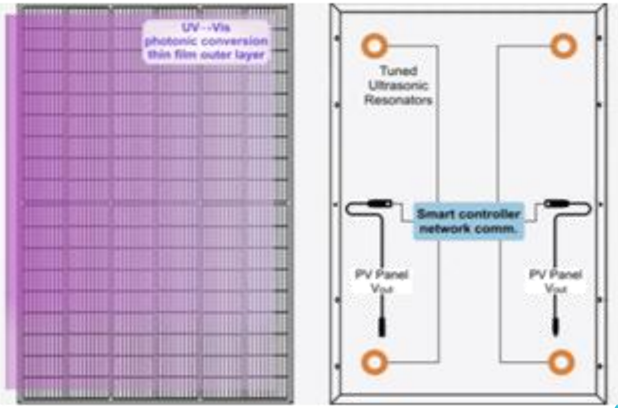
University of Sfax TUNISIA

KUSA

MEBDOUSOLARENERGY

(>2025). Proposal submission (2-stage)
New consortium with industrial partners

Combining photonic /self-cleaning coating layers + Ultrasonic Resonator + Automatized Control Unit



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LEAP-RE

Expected outcomes in case of success of the project (2030)

Mid-term expected results

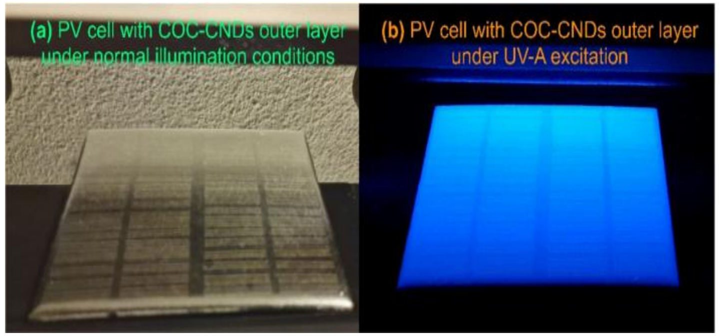
- *To achieve at least 3% increased efficiency of hybrid solar cells.*
- *To construct a prototype of hybrid solar cells for long-term operation and validation of the approach.*
- *To contribute to train young researchers in a multidisciplinary environment .*

After project lifetime

- *To achieve at least 10 % increased lifetime*
- *To achieve al least 5 % reduced cost of solar energy or solar module*
- *To improve the stability of the cells in outdoor conditions and harsh environments compared to conventional cells.*

Risks / Points of vigilance

1. *Conversion efficiency and stability of the photonic conversion layers after coating layers.*
2. *Incorporation of the active materials in the coating layers impacts negatively the cost of the modules.*
3. *Durability of devices in aggressive environmental conditions (e.g., dust, high level of irradiation) in African countries.*



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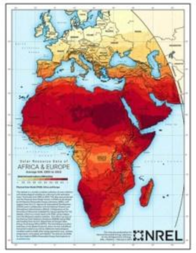
Contribution of the project to AU – EU R&D partnership



Scientific Innovation: provide new solutions to exploit the enormous (solar) energy potential in Africa.

Capacity building: (i) skill transfer through training of personnel; (ii) favoring the use of local renewable sources (local).

Cooperation: know-how share: towards energy transition in Europe and Africa, providing energy access in isolated areas.

Interest of Consortium members in participating in LEAP-RE clustering activities

Topic 1: Mapping joint research and innovation actions for next-step development of RES and integration of RES in sustainable energy scenarios

Topic 3: Smart stand-alone systems

THANK YOU

CONTACT US FOR MORE INFORMATION

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@leapRE_EU

The LEAP-RE project has received funding from the European Union's Horizon 2020 Research and Innovation Program under Grant Agreement 963530.