Luminescent solar concentrators, a step towards energy self-sufficient buildings

Lukáš Zdražil

PALACKY UNIVERSITY OLOMOUC

This project receives funding from the European Commission's Horizon Europe Research Programme under Grant Agreement Number 101120397

OUTLINE

- The Problem & Opportunity
- The Solution – Research Innovation
- Impact
- Call to Action

The Problem & Opportunity

Problem:

- The world’s population consumes around 21.4 TW of power (per year).
- The estimated global demand for electricity by 2050 may reach 30 TW
  (ideally from renewable and sustainable resources).

Possible solution:

- Energy from the sun is limitless – the sun provides us 120 000 TW of power.
- Today solar energy provides only about 1% of the world’s electricity.
- To generate the required amount of energy (with solar cells) only 1% of the land coverage is needed.
- Solar devices should be made of abundant, environmentally benign and
  cost-effective materials.

The Solution – Research Innovation

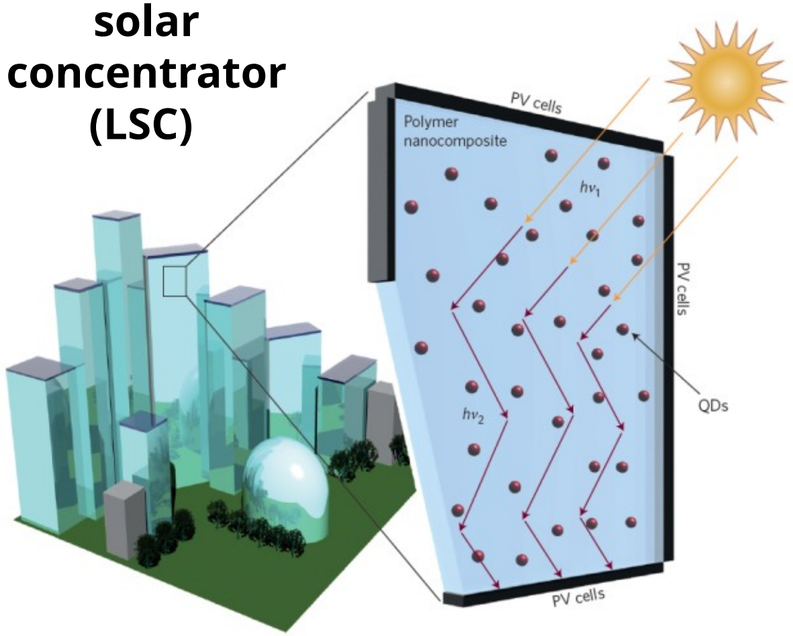
Urban buildings as energetically self-sustainable units

1. Fluorophores embedded in polymer matrix collect and concentrate solar light from the surface of LSC to its edges.
2. Concentrated solar light is afterward converted into electrical energy by solar cells attached along the LSC perimeter.

Requirements for fluorophores:

✓Highly emissive
✓Ecofriendly
✓Cheap
✓Photo-stable

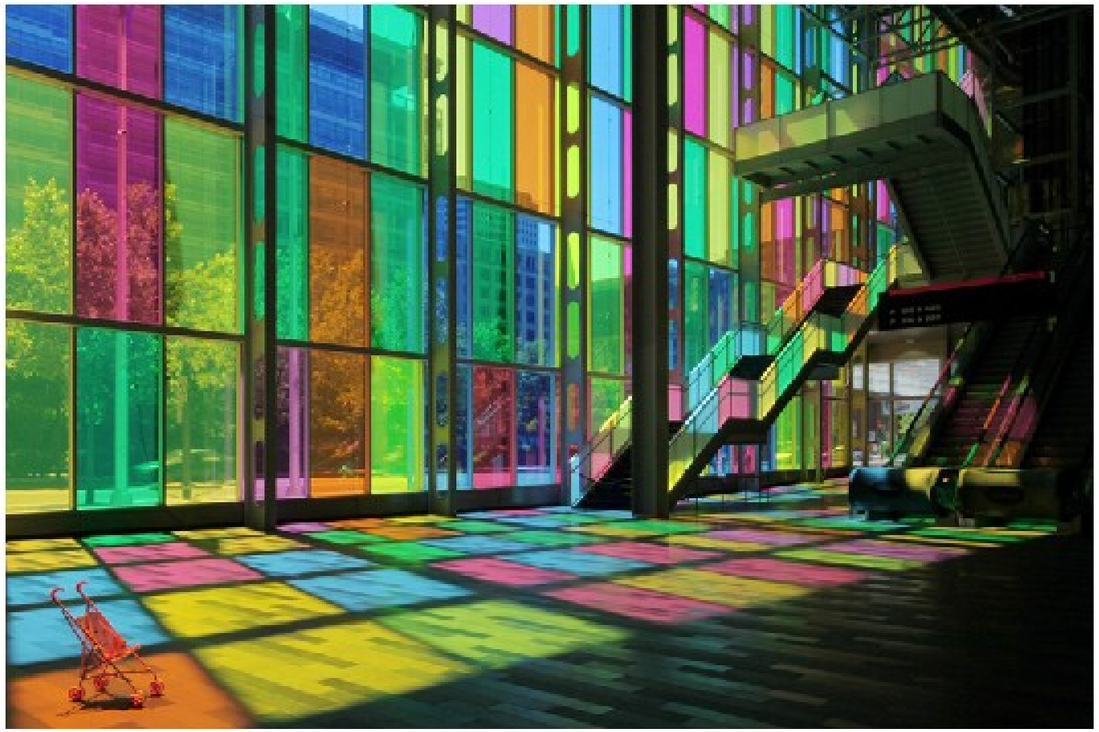
Concept of the luminescent solar concentrator (LSC)



[**Nat. Rev. Mater.** 2017, 2, 17072]

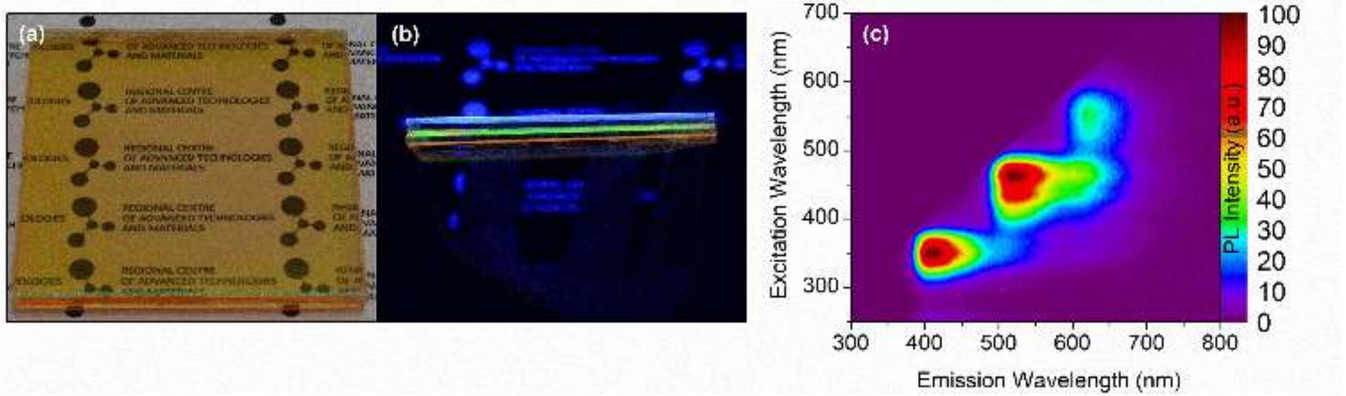
Impact

- Development of a tandem luminescent solar concentrator (LSC) based entirely on eco-friendly carbon dots (CDs).
- Offers a cheap, scalable, and environmentally friendly alternative to semiconductor and perovskite-based LSCs.
- Conversion of previously energy-passive glazed areas of urban buildings into self-sufficient energy units would increase the share of "clean" solar energy while eliminating significant landscape interventions.

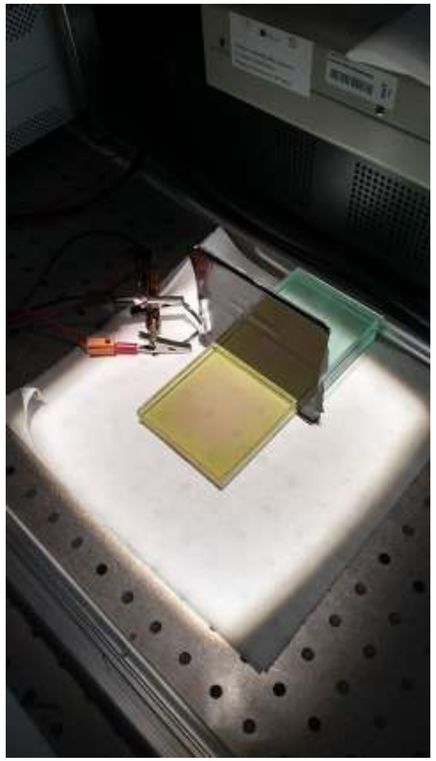


[**Energy and buildings.** 2016, 1, 123-132]

Call to Action



IOQE = 23.6%
EOQE = 2.3%

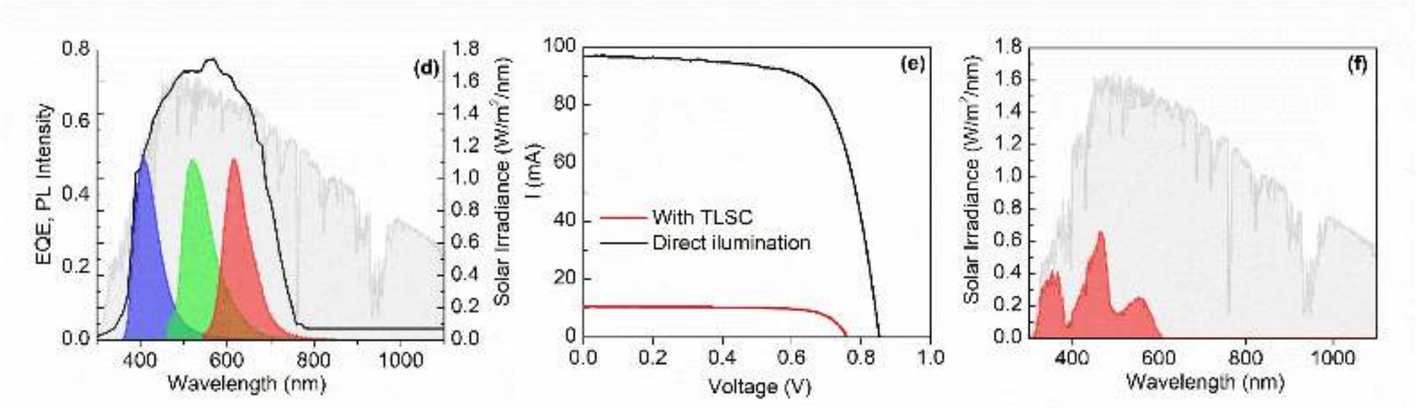


Internal optical quantum efficiency (**IOQE**):

$$\mathrm{IOQE} = \frac{1}{G\eta_{s,abs}} \frac{I_{SC}}{I_{PV}} \frac{Q_{Total}}{Q_{PL}}$$

External optical quantum efficiency (**EOQE**):

$$\mathrm{EOQE} = \eta_{s,abs} \cdot \mathrm{IOQE}$$



Experimental setup for electro-optical measurements of tandem LSC coupled to the a-Si solar cell.

APPROACH

THANK YOU

euproject-approach.eu/

This project receives funding from the European Commission’s
Horizon Europe Research Programme under Grant Agreement Number 101120397