MONASH University

MONASH INNOVATION

FLUOROPHORES FOR LIGHT HARVESTING

A new class of organic fluorophores that possess chemical and photophysical properties desirable for the development of totally transparent and aesthetically pleasing luminescent solar concentrators (LSCs). Applications may include power generation from any transparent surface exposed to incident sunlight when optically coupled with a suitable photovoltaic device.

- **Near unity fluorescence quantum yields**
- **Large stokes shifts (sky blue emission)**
- **Thermally stable > 250 °C**
- **Facile synthesis**

THE CHALLENGE

Light harvesting and conversion to clean electrical power is a modern world challenge of monumental scale. While novel photovoltaic technologies aim to maximise the absorption and efficient conversion of incident solar sunlight, the trade-off of such devices is that they are highly coloured.

An alternative is to use transparent surfaces to capture light, which can be concentrated within a waveguide and optically coupled to a photovoltaic. Potential applications include self-charging mobile devices.

This approach has not been widely adopted due to the lack of fluorophores that meet the strict chemical and photophysical requirements to develop a commercially viable device.

THE TECHNOLOGY

Monash researchers have identified a class of organic molecules that meet the criteria for utility in transparent LSC technology. The optical and photophysical properties are tunable, providing for product scope. Various luminophores previously used in LSCs are compared in Table 1.

The pyridinium betaine absorbs light in the UV and near visible region of the electromagnetic spectrum (Fig 1). Through a molecular process, this energy is converted and re-emitted as aesthetically pleasing sky-blue light (CIE 0.1542, 0.1773) (Fig. 2).

Luminophore	Absorption λ_{max} (nm)	Emission λ_{max} (nm)	Quantum Yield (%)	Visibly Coloured
Rhodamine 6G	528	558	95	Yes
Lumogen F Red305	578	613	98	Yes
Perylene Derivative	577	674	70	Yes
Cyanine Salt	742	772	20–30	No
CdSe/CdS QDs	<500	650	86	Yes
Mn^{2+}:ZnSe/ZnS NCs	400	600	37	Yes*
$CuInSe_xS_{2-x}$/ZnS QDs	500	960	40	Yes
CdSe/Cd_xPb_{1-x}S QDs	460	625	40	Yes
$(TBA)_2Mo_6Cl_{14}$ NCs	325	750	75	No
$Eu(TTA)_3(TPPO)_2$	577	674	70	Yes*
UNIMELB 1e	403	473	>99 %	Pale Yellow

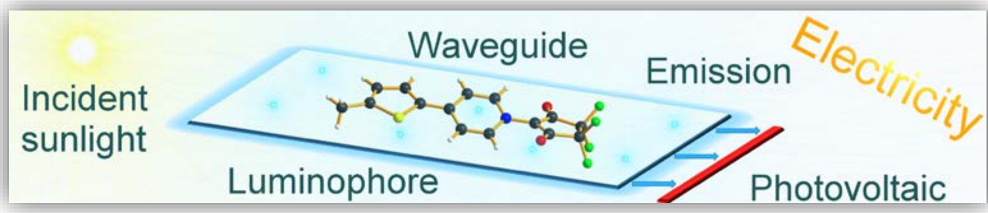

Figure 1. Graphical representation of a typical LSC

As the compound is thermally stable and soluble in most common solvents due to it's zwitterionic nature, a range of host materials and fabrication. The material also shows little fluorescence self-quenching, minimal re-absorption events and high PLQY yields.

INTELLECTUAL PROPERTY: Technology protected by PCT/AU2018/050629

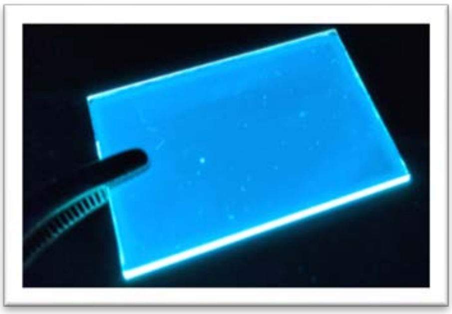

Figure 2. Emission on exposure to UV irradiation.

THE OPPORTUNITY

Monash seeks a partner to optimise and assist with the fabrication of the technology for application.

Dr. Chris Ritchie is an ARC Future Fellow and emerging expert in the research areas of fluorescent and photochromic molecular materials. He leads a research team out of the School of Chemistry.

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