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Lifetime of inkjet printing OPV modules for indoor applications.

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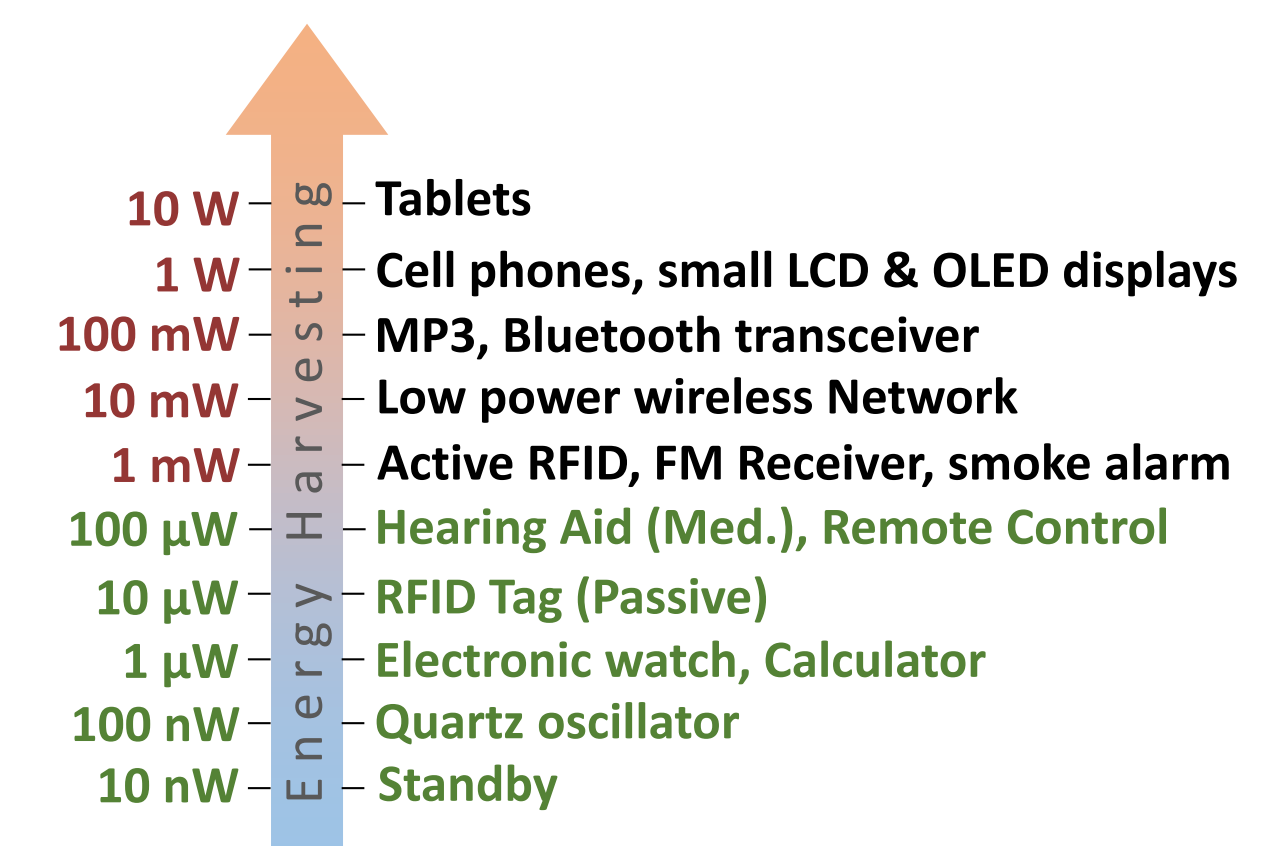
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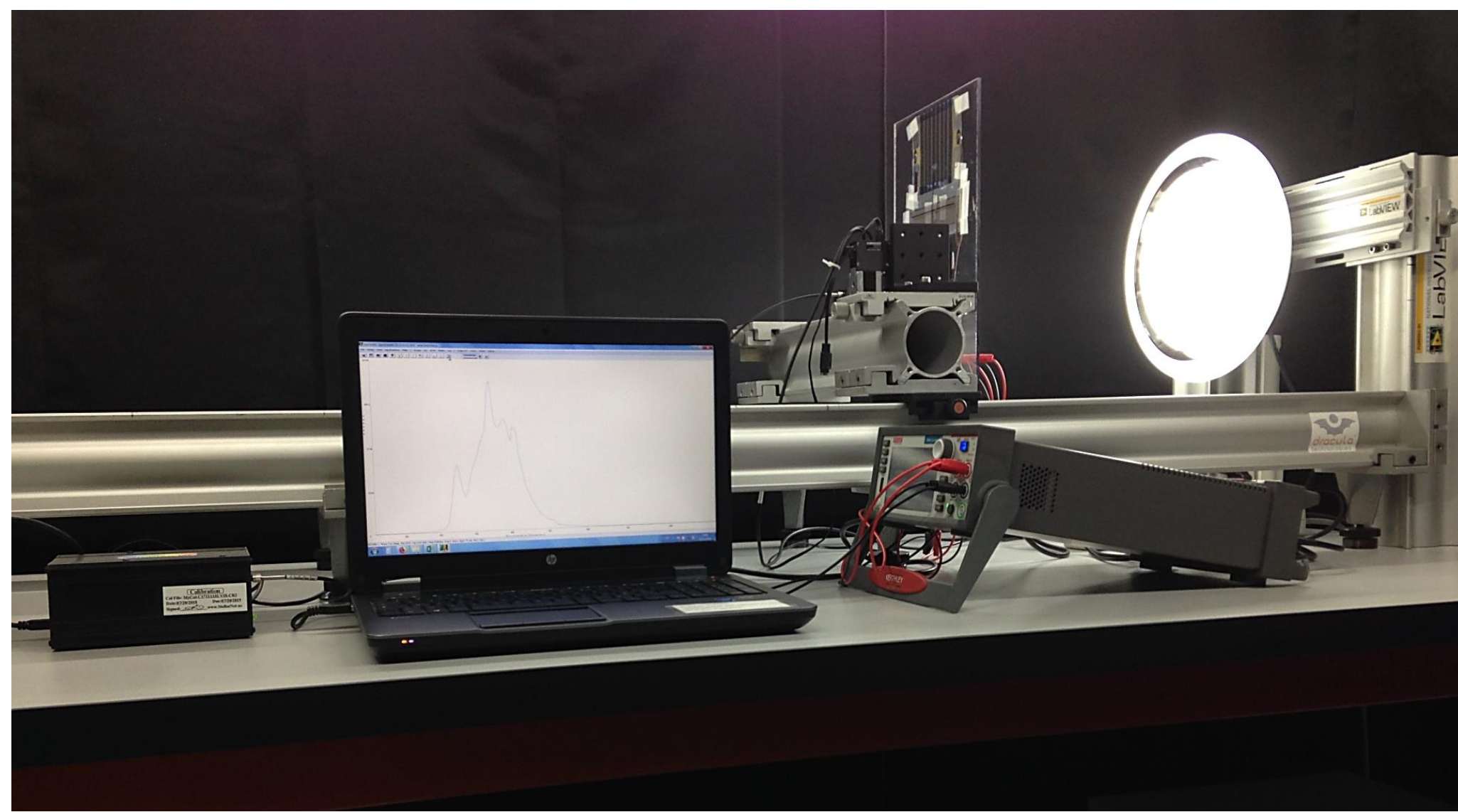
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Introduction

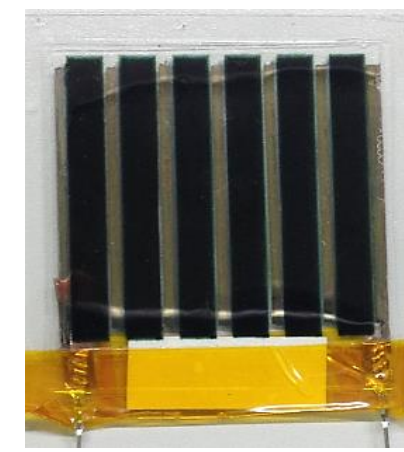
Harvesting energy from their environment could be an ideal solution for an autonomous function of numerous small electronics. Organic Photovoltaic (OPV) cells are a promising technology for next generation photovoltaic cells combining novel properties such as light weight, flexibility, or color design with large-scale manufacturing with low environmental impact. Furthermore, the OPV cells are good solution for Indoor applications. In this field, DRACULA TECHNOLOGIES (DT) has developed inkjet printing organic solar cells and modules. The great advantage of inkjet printing as a digital technology is the freedom of forms and designs, large area organic modules with different artistic shapes. The stability of OPV cells are critical element for up-scaling and commercialization of this technology. To evaluate the stability and lifetime of the DT modules, the ISOS-D-1 (shelf lifetime) protocol is applied for 175 days. The devices were stored under dark ambient conditions and a LED light source is used for the periodical characterizations.



Test bench (module & light source specifications)



PV INDOOR test bench

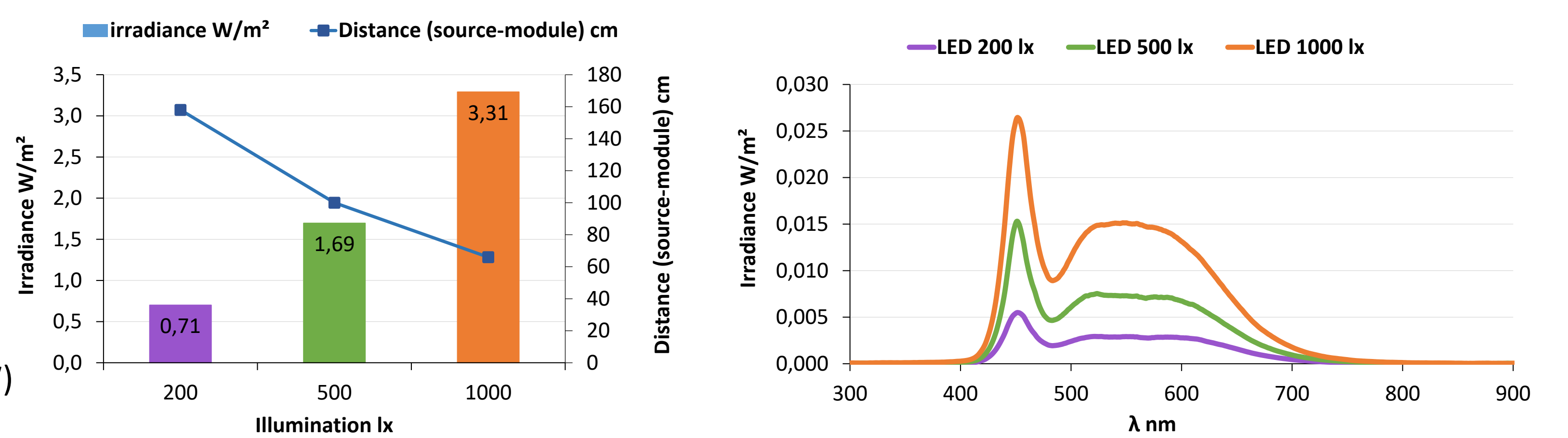


OPV test module



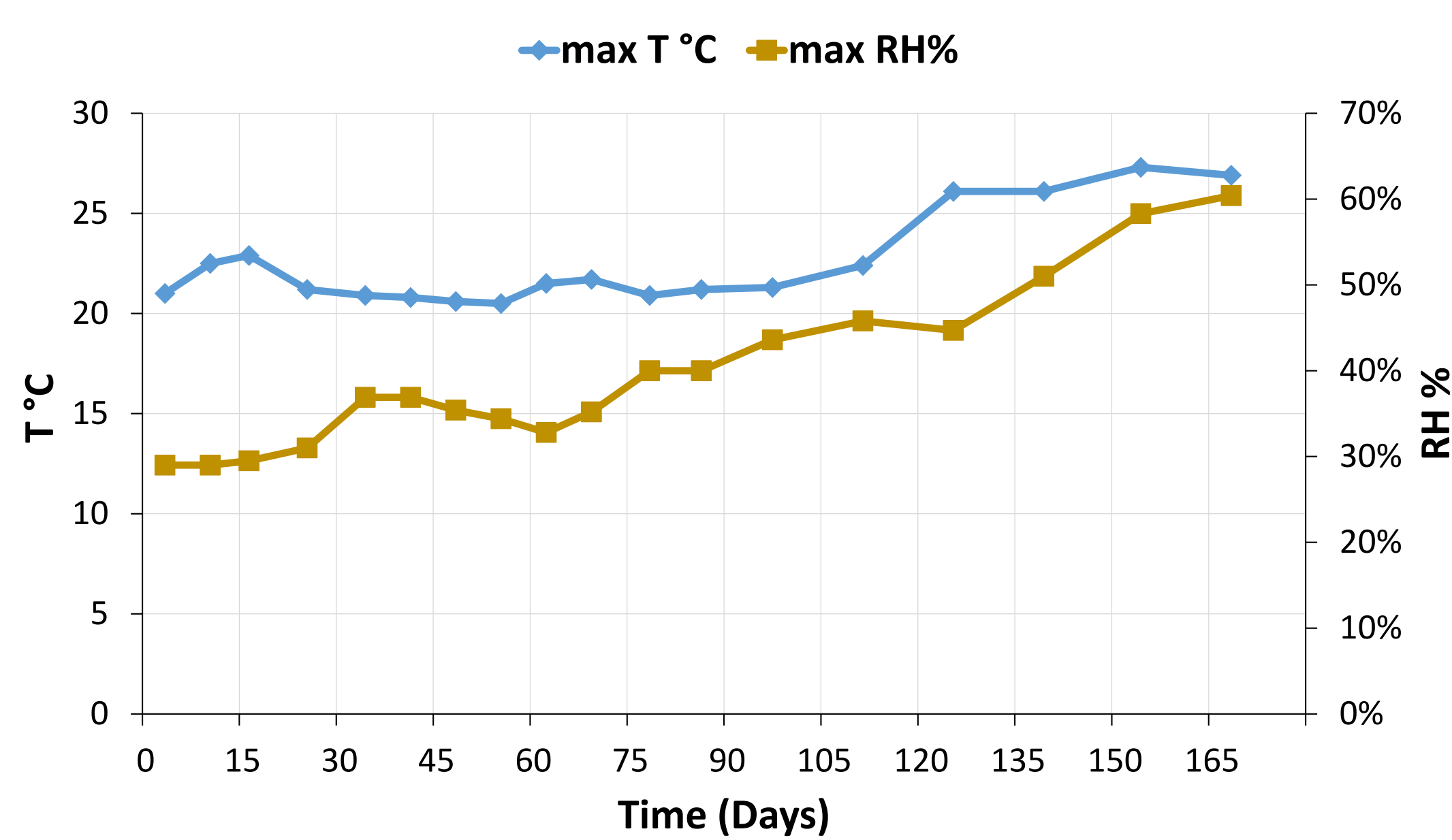
LED ceiling lamp
(2100 lm, 6500 K, 17 W)

Structure	Layers	Encapsulation	Filtre UV	Substrat	Cell number	Configuration	Active area	Illumination level	Efficiency % at the 1st characterization (time = 0)
Inverted	PET/ITO/AZO/Active Layer/PEDOT-PSS/Ag	Low film barrier properties (10 ⁻¹ g/m ² /d)	---	Flexible	6	Serial	8 cm ²	200 lx	3,24 %
								500 lx	3,67 %
								1000 lx	4,44 %

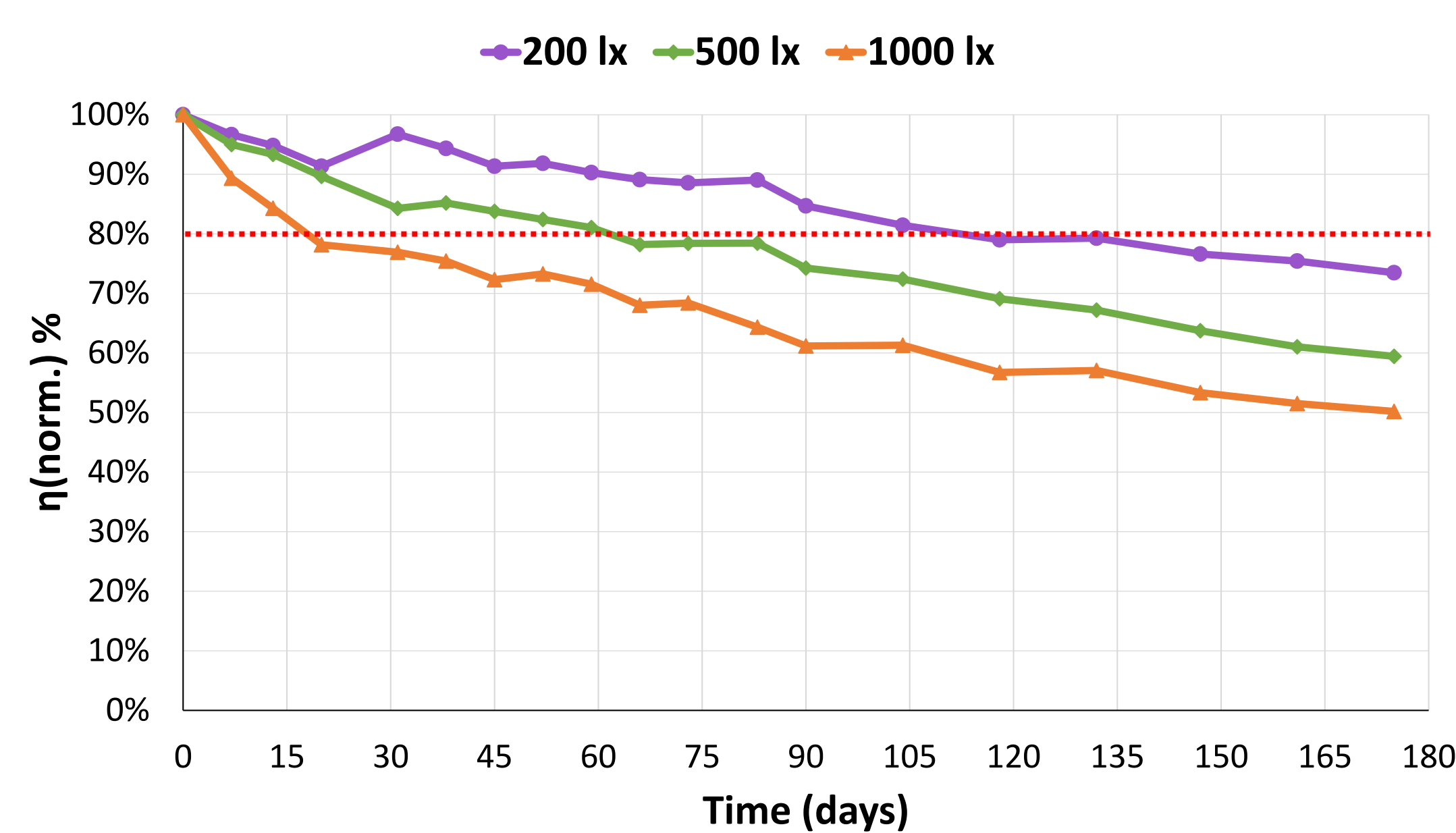


Results

Temperature and relative humidity evolution during the storage phases (from 25 jan. 2019 to 19 July 2019).



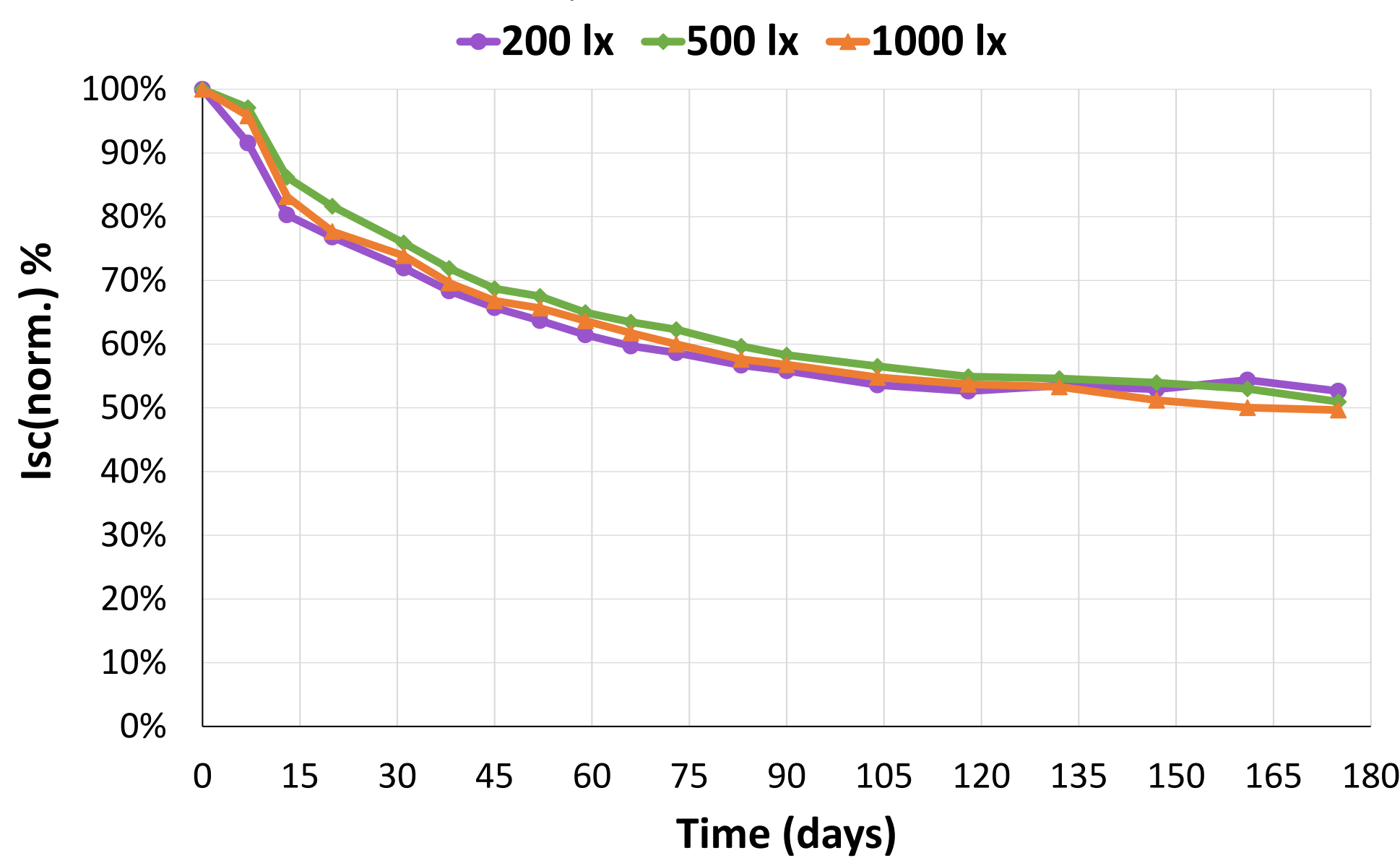
Degradation curves of efficiency (normalized to the initial value at time = 0) for 3 Illumination levels.



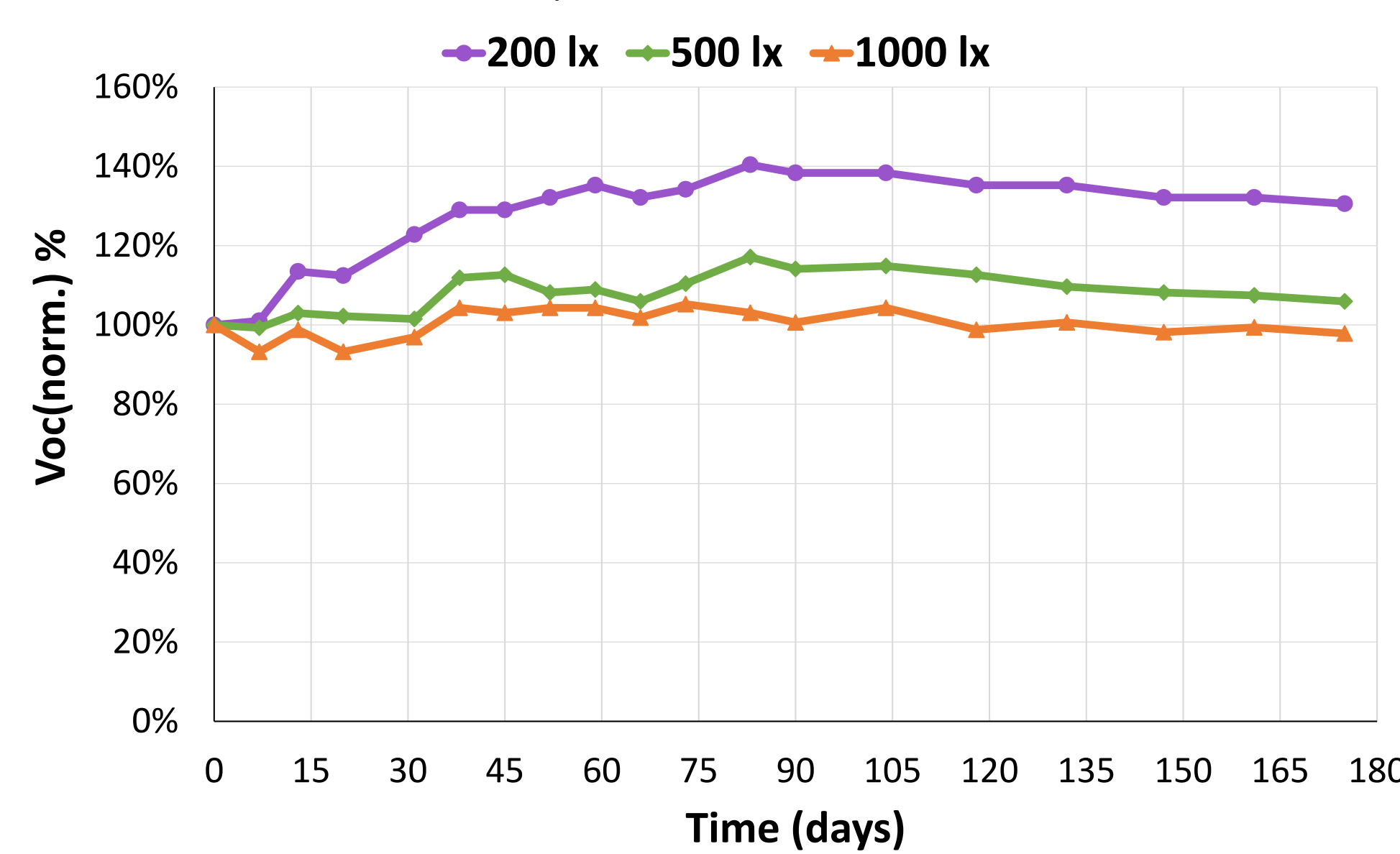
T₈₀ : Time for the efficiency to decrease to 80% of the initial value at time = 0.

Illumination level	T ₈₀
200 lx	118 days
500 lx	66 days
1000 lx	20 days

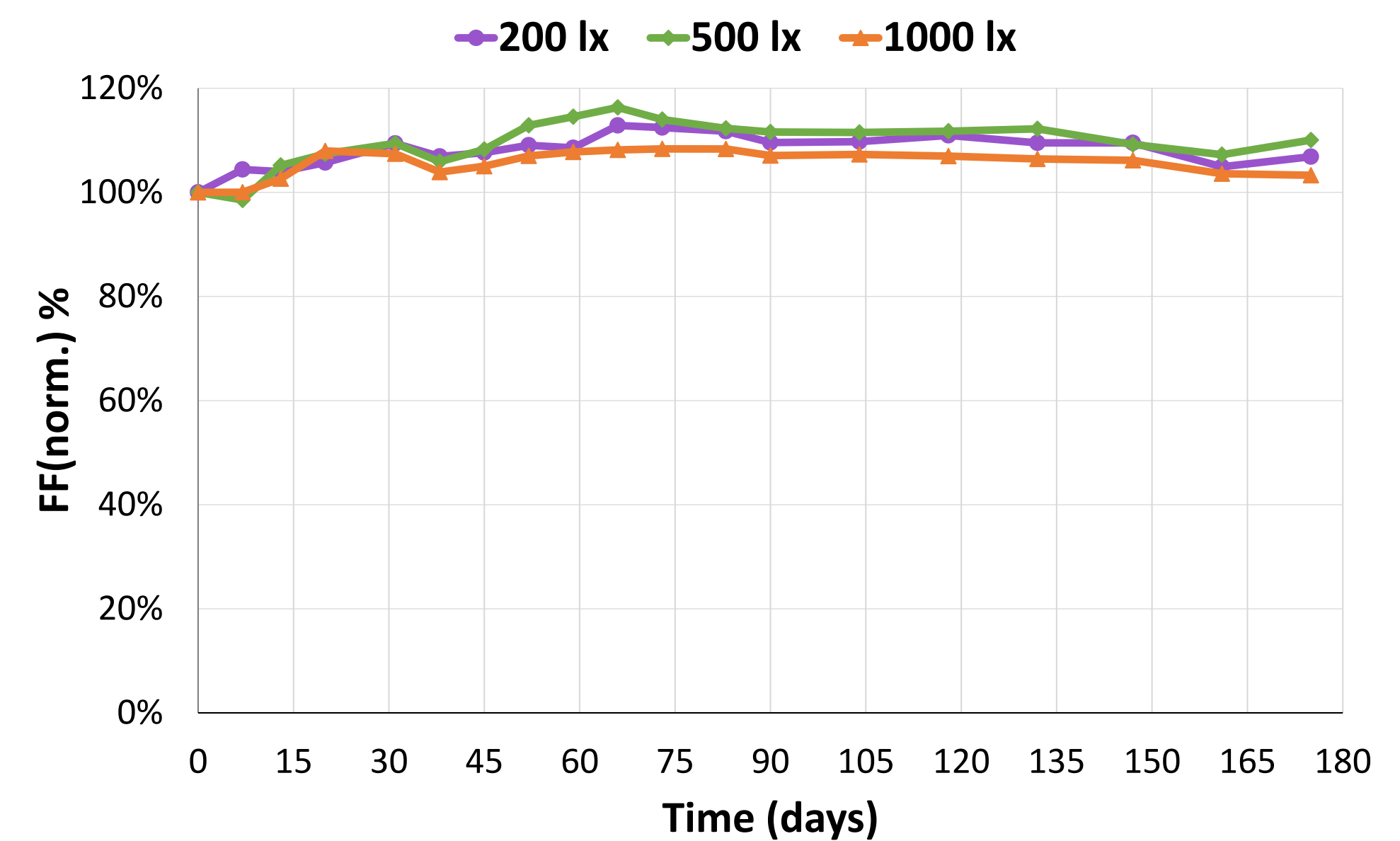
Degradation curves of I_{sc} (normalized to the initial value at time = 0) for 3 Illumination levels.



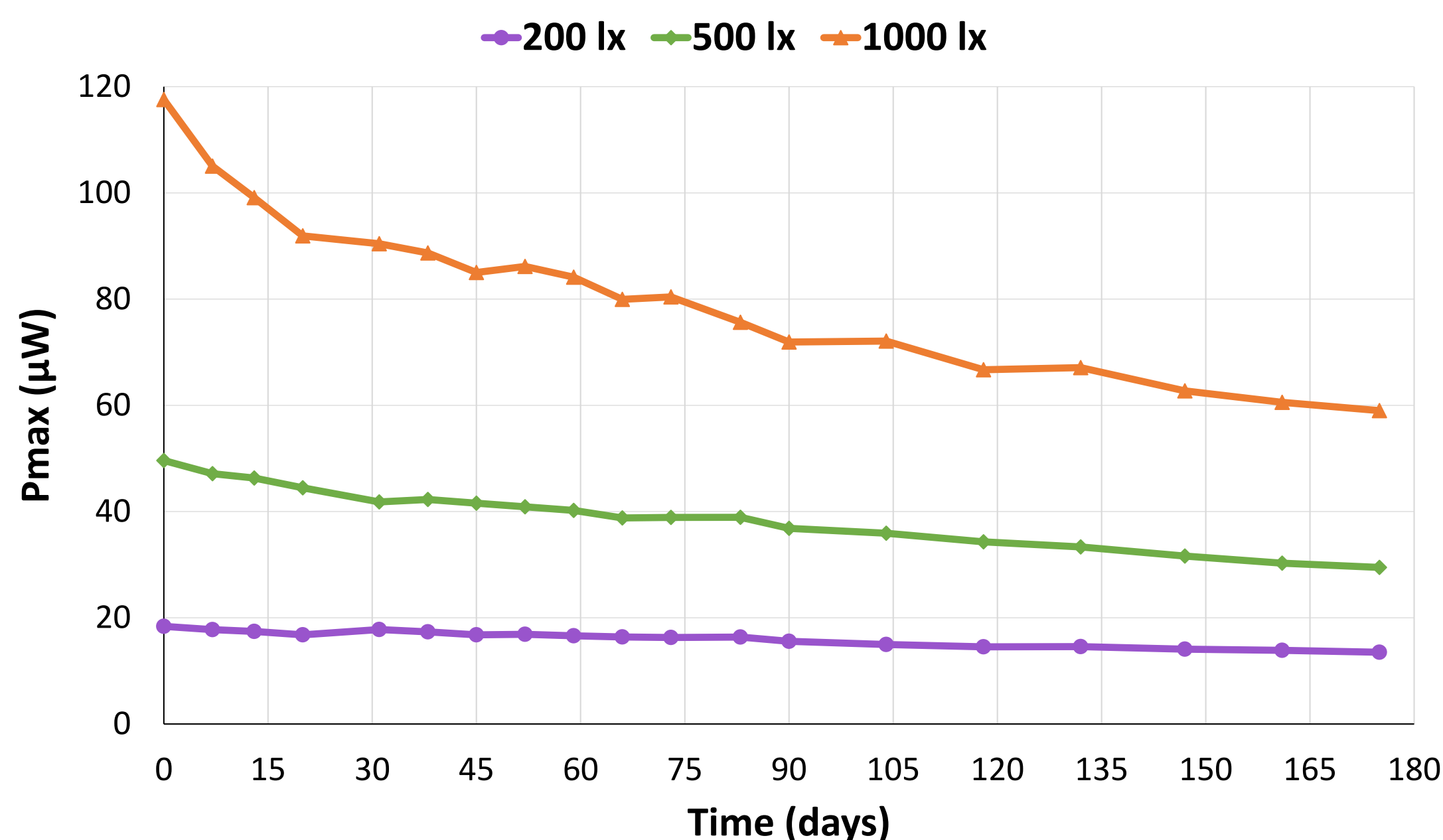
Degradation curves of V_{oc} (normalized to the initial value at time = 0) for 3 Illumination levels.



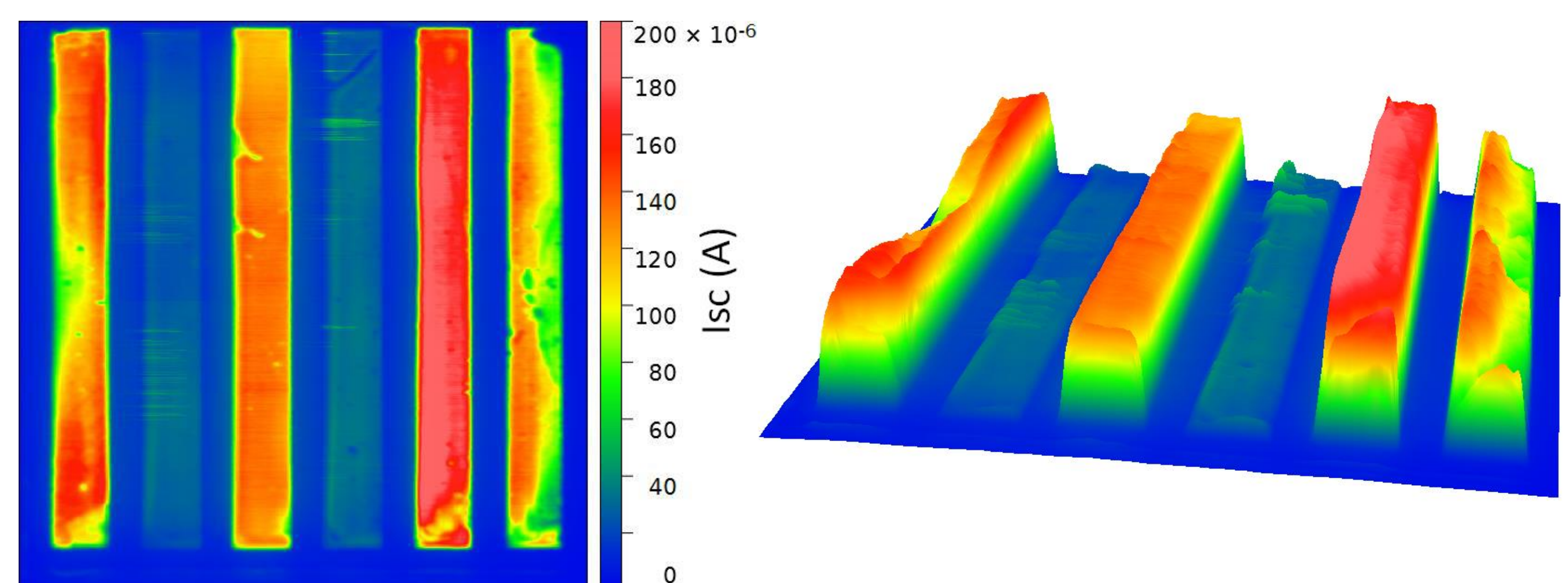
Degradation curves of the fill factor (normalized to the initial value at time = 0) for 3 Illumination levels.



Degradation curves of P_{max} (μW) for 3 Illumination levels.



LBIC (Light Beam Induced Current) mapping (in 2D and 3D) of the presented module at time = 175 days.



Conclusions

One of the specifications required for OPV cells market is the stability of the devices. The diffusion of oxygen and moisture through the encapsulation system is the main factor responsible of the device degradation. However, the obtained results confirm the adaptability of inkjet printing OPV modules to powered small electronics, as in IoT (Internet of Things) applications, at low illumination indoor environment.

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