Electronic Supplementary Information (ESI)

Toward Efficient Solid-State p-Type Dye-Sensitized Solar Cells: The Dye Matters

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Table S1. Photovoltaic parameters of solid-state p-type DSSC based on **PCBM** and on the **DPP-PYRO** dye, with different concentration of **CDCA** treatment (spincoating **CDCA** solution of on the sensitized samples, no rinsing before **PCBM** coating). The treatment is intended to assist the coverage of NiO after dye-loading to prevent NiO surface being exposed to PCBM causing recombination. The solar cells were placed under standard solar illumination at 100 mW cm^{-2} and AM1.5G spectral distribution. NiO film thickness is 0.65 µm.

CDCA concentration	V_{oc} (mV)	J_{sc} (mA.cm^{-2})	FF	η (%)
0	119	0.05	0.26	0.001
2mM	189	0.11	0.28	0.006
5mM	187	0.09	0.29	0.005
10mM	237	0.27	0.27	0.017
20mM	260	<0.01	0.25	<0.001

Table S2. Photovoltaic parameters of solid-state p-type DSSC based on **PCBM** and on **DPP-PYRO** and **DPP-Br** dyes, as a function of porous NiO layer thickness. The solar cells were placed under standard solar illumination at 100 mW cm^{-2} and AM1.5G spectral distribution.

Dye	Thickness of porous NiO (µm)	V_{OC} (mV)	J_{SC} (mA cm^{-2})	FF	η (%)
DPP-PYRO	0.65	228	0.32	0.32	0.023
	1.5	182	0.07	0.30	0.004
	1.7	127	0.13	0.25	0.004
DPP-Br	0.65	198	0.45	0.32	0.028
	1.5	116	0.10	0.29	0.003
	1.7	96	0.03	0.25	0.001
No dye	0.65	3	< 0.01	0.25	< 0.001

Table S3. Fitting parameters used to adjust the experimental PL decay traces with bi-exponential decay functions, for the three dyes grafted on Al_2O_3, without and in the presence of **PCBM**.

		a_1 (arb. units)	τ_1 (ps)	a_2 (arb. units)	τ_2 (ps)
P1	No PCBM	0.014	433	0.0031	1408
	With PCBM	0.015	337	0.0034	1205
DPP-Br	No PCBM	0.021	841	0.0092	3634
	With PCBM	0.051	253	0.0064	1694
DPP-PYRO	No PCBM	0.020	281	0.0016	1578
	With PCBM	0.042	100	0.0018	961

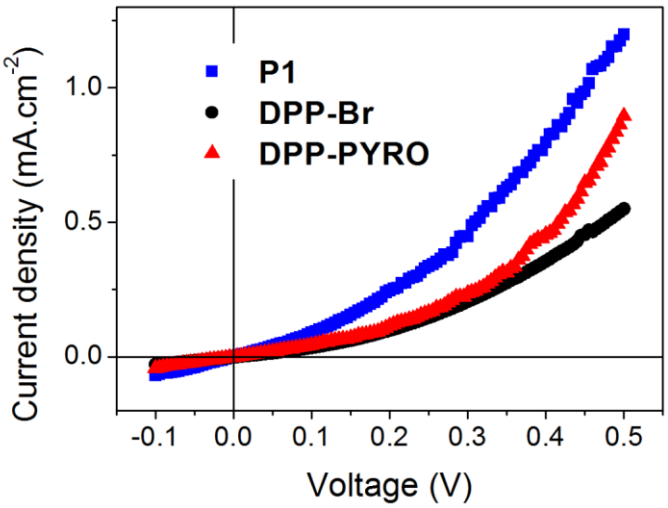

Figure S1. Current density – voltage characteristics in the dark of solid-state p-type DSSC based on **PCBM** and on **DPP-PYRO** (red triangles), **DPP-Br** (blue circles), and **P1** (black squares) dyes.

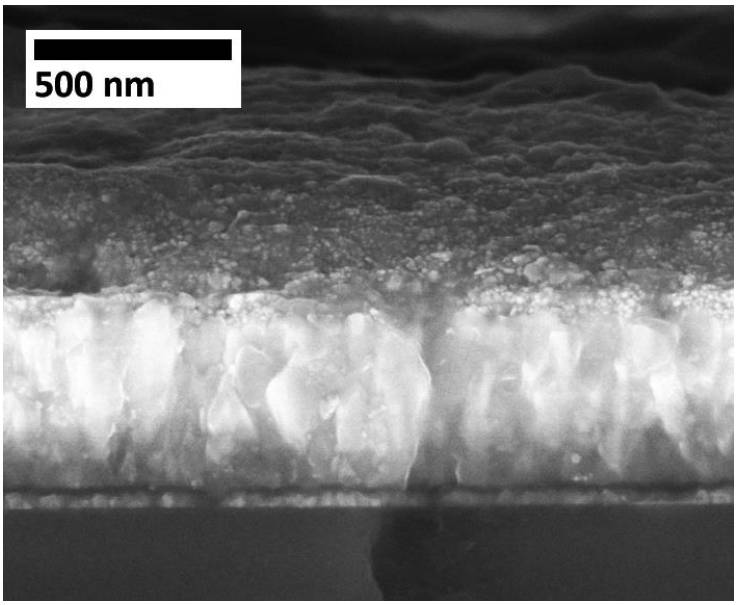

Figure S2. SEM cross-section of sample FTO/dense NiO/Porous NiO/**DPP-Br**/PCBM.

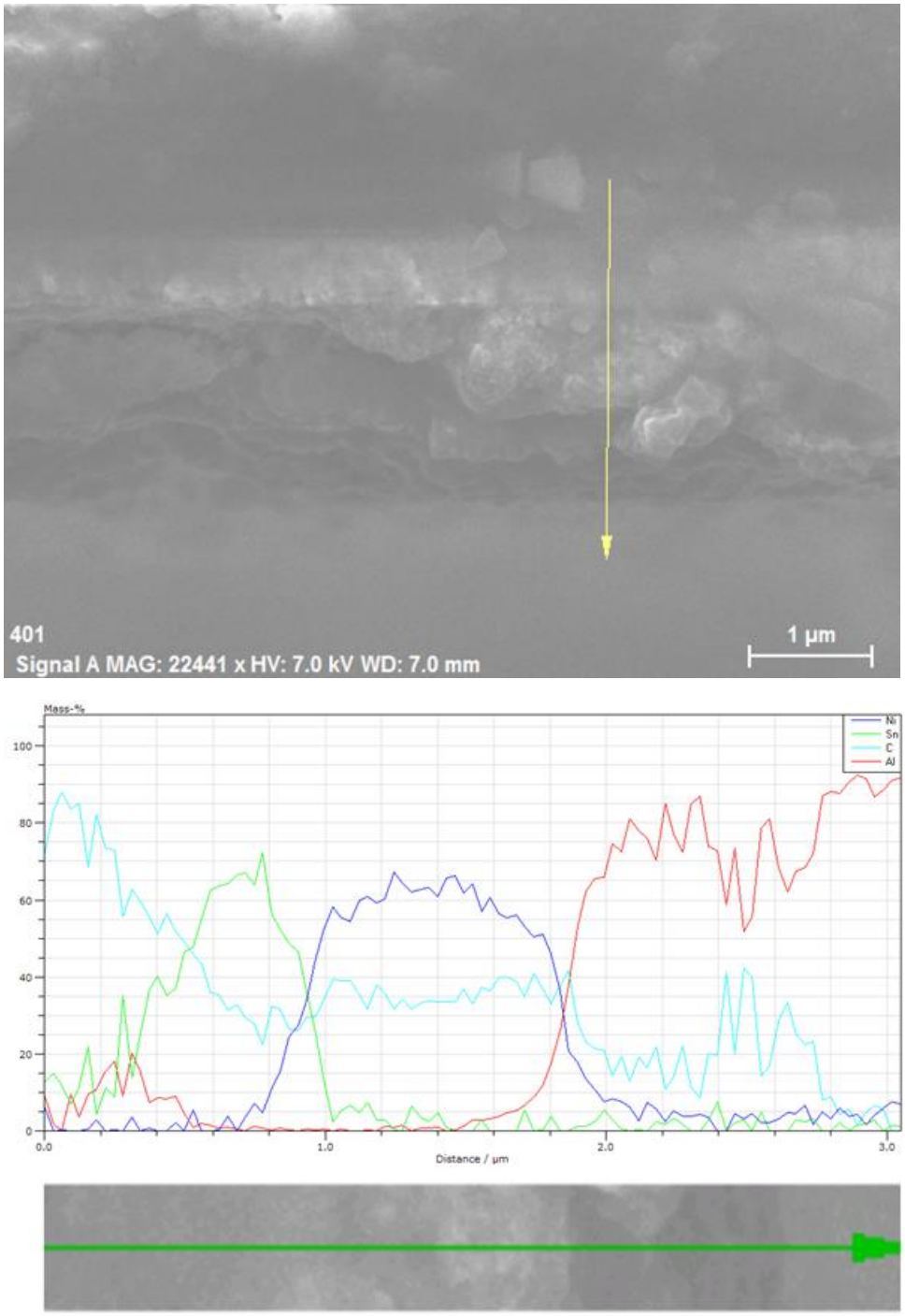

Figure S3. SEM image and corresponding EDX profiles for Ni, Sn, and C, for sample FTO/dense NiO/Porous NiO/**P1**/PCBM.

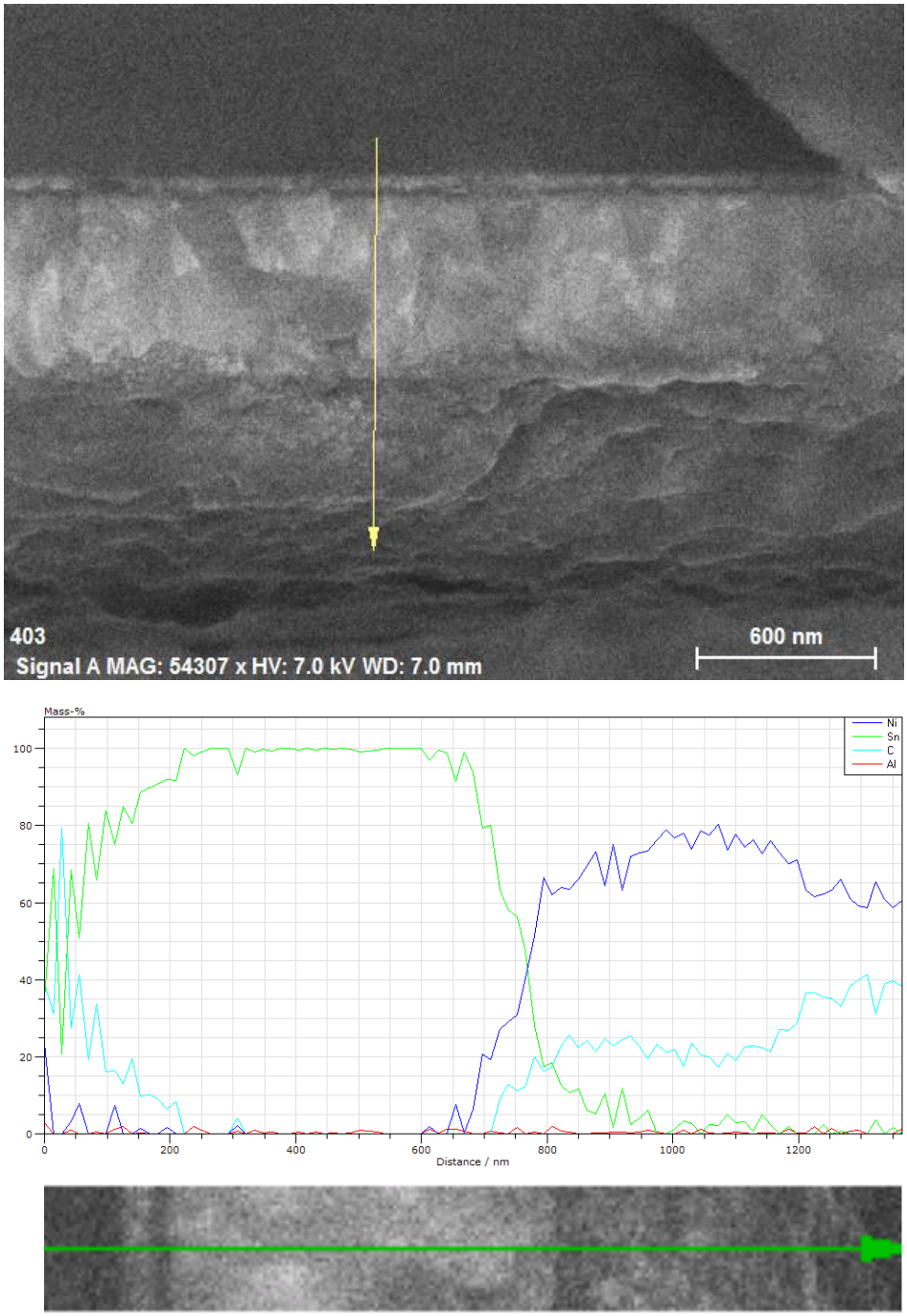

Figure S4. SEM image and corresponding EDX profiles for Ni, Sn, and C, for sample FTO/dense NiO/Porous NiO/**DPP-Br**/PCBM.

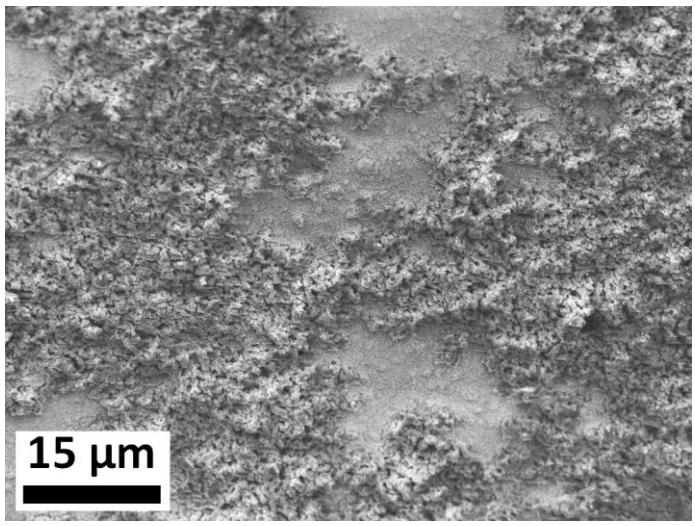

Figure S5. Top SEM image of sample FTO/dense NiO/Porous NiO/**DPP-PYRO**/PCBM showing a strong aggregation of **PCBM** on top of the device stacking.

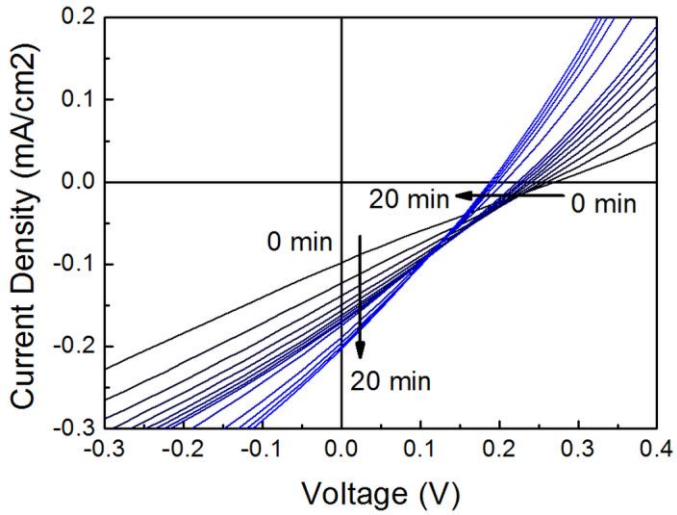

Figure S6. Electrical characteristics of solid-state p-type DSSC based on dye **P1** and **PCBM**, as a function of illumination time at 100 mW cm^{-2} (AM1.5G). The measurements were made under inert atmosphere in a glovebox.

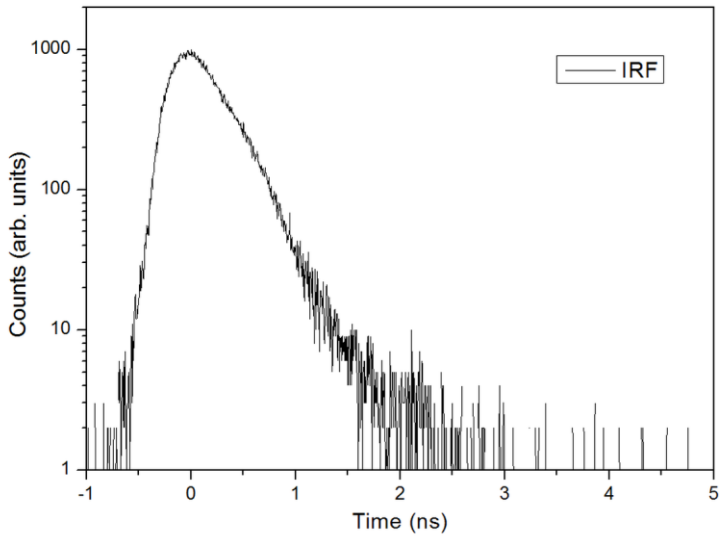

Figure S7. Instrument Response Function (IRF) of the apparatus used for the measurement of photoluminescence decays (Edinburgh Instrument FLS 980).

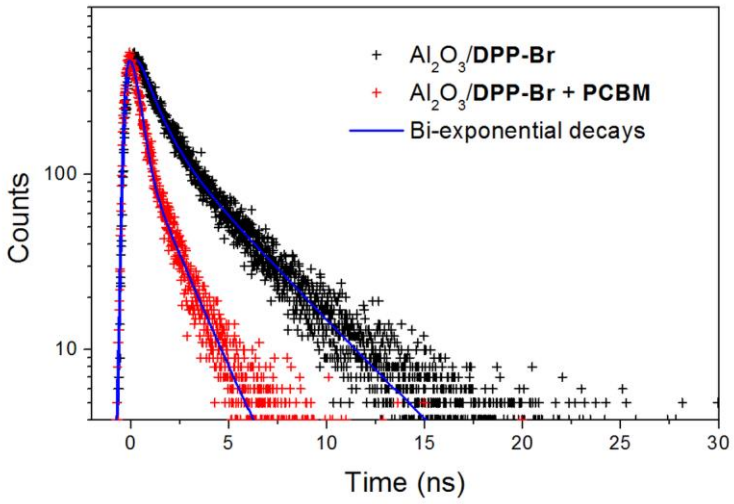

Figure S8. Time-resolved photoluminescence traces for system based on dye **DPP-Br** grafted on Al_2O_3, without (black data) and in the presence of **PCBM** (red data). The excitation is performed at 510 nm, and the emission is detected at 616 nm. The deconvolutions of the spectra using bi-exponential decay functions and taking into account the IRF, are plot as solid blue lines.

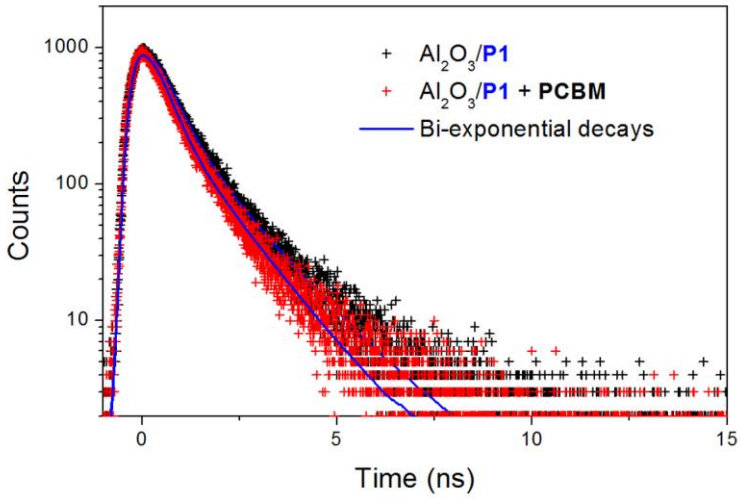

Figure S9. Time-resolved photoluminescence traces for system based on dye **P1** grafted on Al_2O_3, without (black data) and in the presence of **PCBM** (red data). The excitation is performed at 510 nm, and the emission is detected at 720 nm. The deconvolutions of the spectra using bi-exponential decay functions and taking into account the IRF, are plot as solid blue lines.