Supporting information

Characterization of nanostructured hybrid and organic solar cells by impedance spectroscopy

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Impedance data fits:

	Ionic liquid cell at 0.4V		Ionic liquid cell at V_{OC} (=0.65V)		Defective cell at 0.45V	
Parameter	value	Error (%)	value	Error (%)	value	Error (%)
R_S (Ω)	17.6	0.7	16.5	0.4	52.3	0.2
C_{BL} (F)	$3.30\ 10^{-6}$	4.7	--	--	--	--
$R_{tr} = r_{tr}L$ (Ω)	66.3	3.2	--	--	51.2	4.6
$R_{rec}=r_{rec}/L$ (Ω)	561	0.8	22.6	0.1	22.8	2.7
Q_μ (F s^{n-1})	$3.52\ 10^{-5}$	2.8	$2.67\ 10^{-4}$	2.7	$4.09\ 10^{-5}$	5.2
n	0.93	0.6	0.95	0.5	0.98	0.7
C_μ (eq.)=$c_\mu L$ (F)	$2.56\ 10^{-5}$	0.8	$2.03\ 10^{-4}$	0.6	$3.55\ 10^{-5}$	1.2
R_{Pt} (Ω)	--	--	3.8	2.8	--	--
Q_{Pt} (F s^{n-1})	--	--	$3.6\ 10^{-5}$	24.4	--	--
n	--	--	0.77	3.0	--	--
C_{Pt} (eq.) (F)	--	--	$2.5\ 10^{-6}$	11.0	--	--
R_d (Ω)	81.7	9.2	5.8	2.1	--	--
ω_d (rad s^{-1})	0.52	19.8	0.59	5.3	--	--

Table S1: Values and errors of the elements used in the fits of illuminated samples shown in Fig. 18. In some cases it is needed the use of constant phase elements instead of ideal capacitances to obtain a good fit of the data. The equivalent capacitances are

calculated according to eq. S1.

To calculate the equivalent capacitance of a CPE we use

$$C(eq) = \frac{(RQ)^{1/n}}{R} \qquad \text{(S1)}$$

With Q the CPE prefactor, n the CPE index and R the resistor in parallel to the CPE.

Electron distribution in dark and light at different diffusion lengths

Fig. SI 1-3: (a) Carrier distribution by diffusion-recombination of electrons and photogeneration profile in a nanostructured film with $L = 10\,\mu$m and diffusion length as indicated, in dark and under incident photon flux ϕ_0 = 1.45 x 10^{17} cm^{-2} s^{-1}, at the indicated potentials at the contact. parameters: absorption coefficient $\alpha_{abs} = 500\,cm^{-1}$, diffusion coefficient $D_0 = 10^{-5}\,cm^2\,s^{-1}$, T = 300 K, $E_{F0} = 0\,eV$, $E_c = 1\,eV$, $N_c = 10^{20}\,cm^{-3}$. (b) The Fermi level of electrons and (c) current density-potential for the same model system.

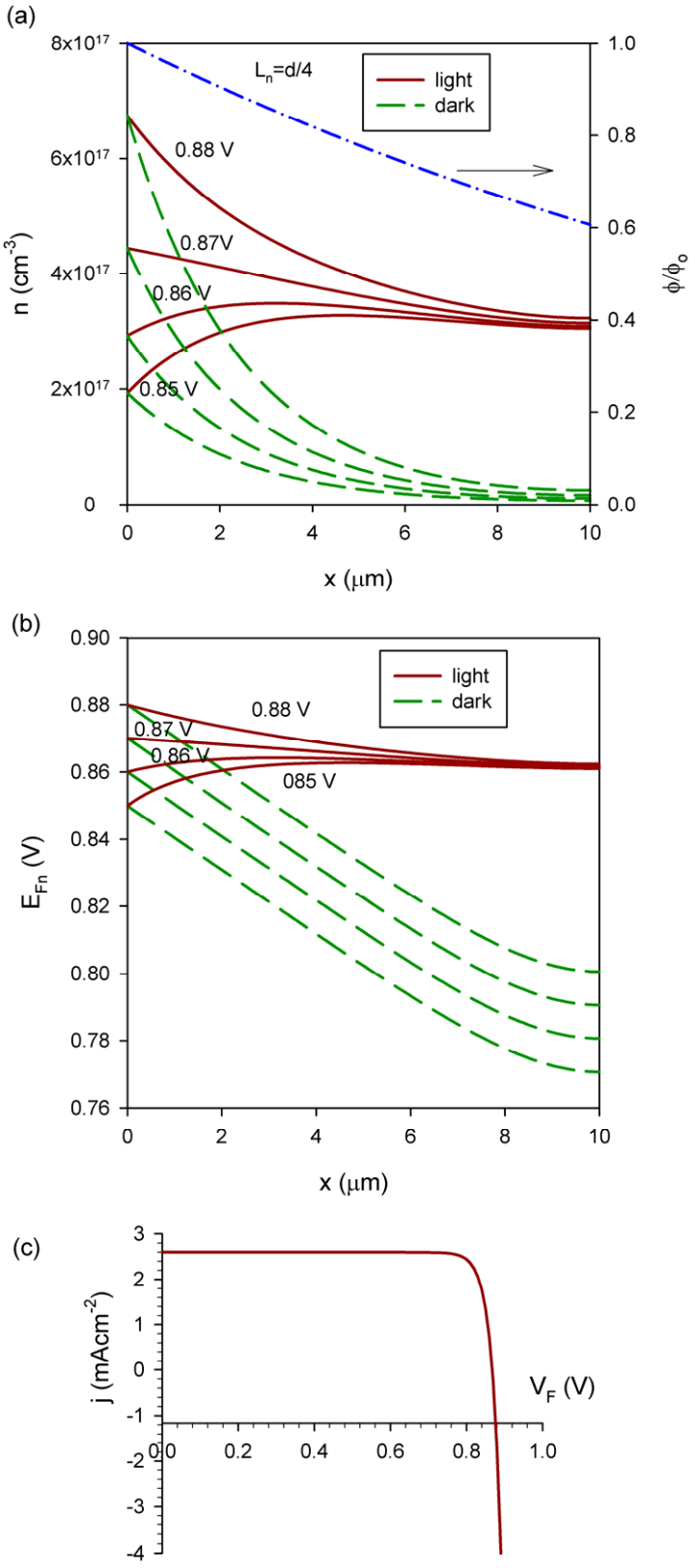
(a)
8x10^17
6x10^17
4x10^17
2x10^17
0
n (cm^-3)
L_n=d/4
light
dark
0.88 V
0.87V
0.86 V
0.85 V
1.0
0.8
0.6
0.4
0.2
0.0
ϕ/ϕ_o
0
2
4
6
8
10
x (μm)
(b)
0.90
0.88
0.86
0.84
0.82
0.80
0.78
0.76
E_Fn (V)
light
dark
0.88 V
0.87 V
0.86 V
085 V
0
2
4
6
8
10
x (μm)
(c)
3
2
1
0
-1
-2
-3
-4
j (mAcm^-2)
V_F (V)
0.0
0.2
0.4
0.6
0.8
1.0

Fig. SI 1

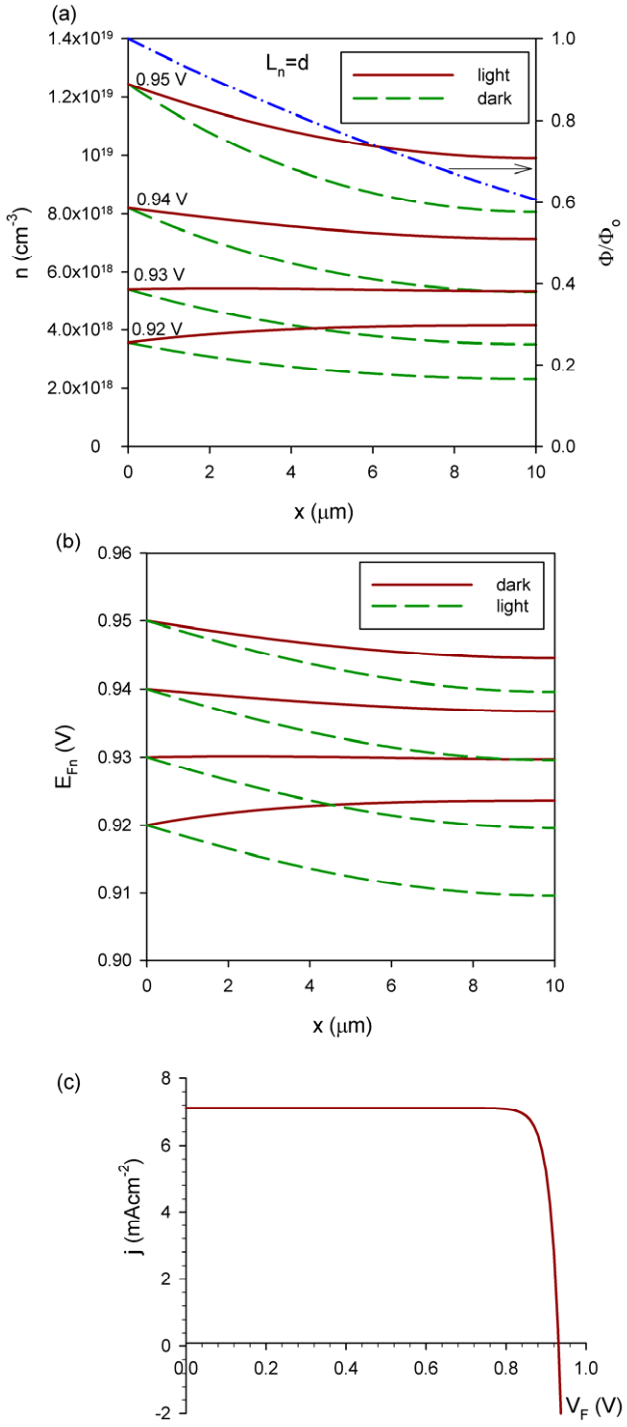
(a)
L_n=d
light
dark
0.95 V
0.94 V
0.93 V
0.92 V
n (cm^-3)
Φ/Φ_o
x (μm)
(b)
dark
light
E_Fn (V)
x (μm)
(c)
j (mAcm^-2)
V_F (V)

Fig. SI 2

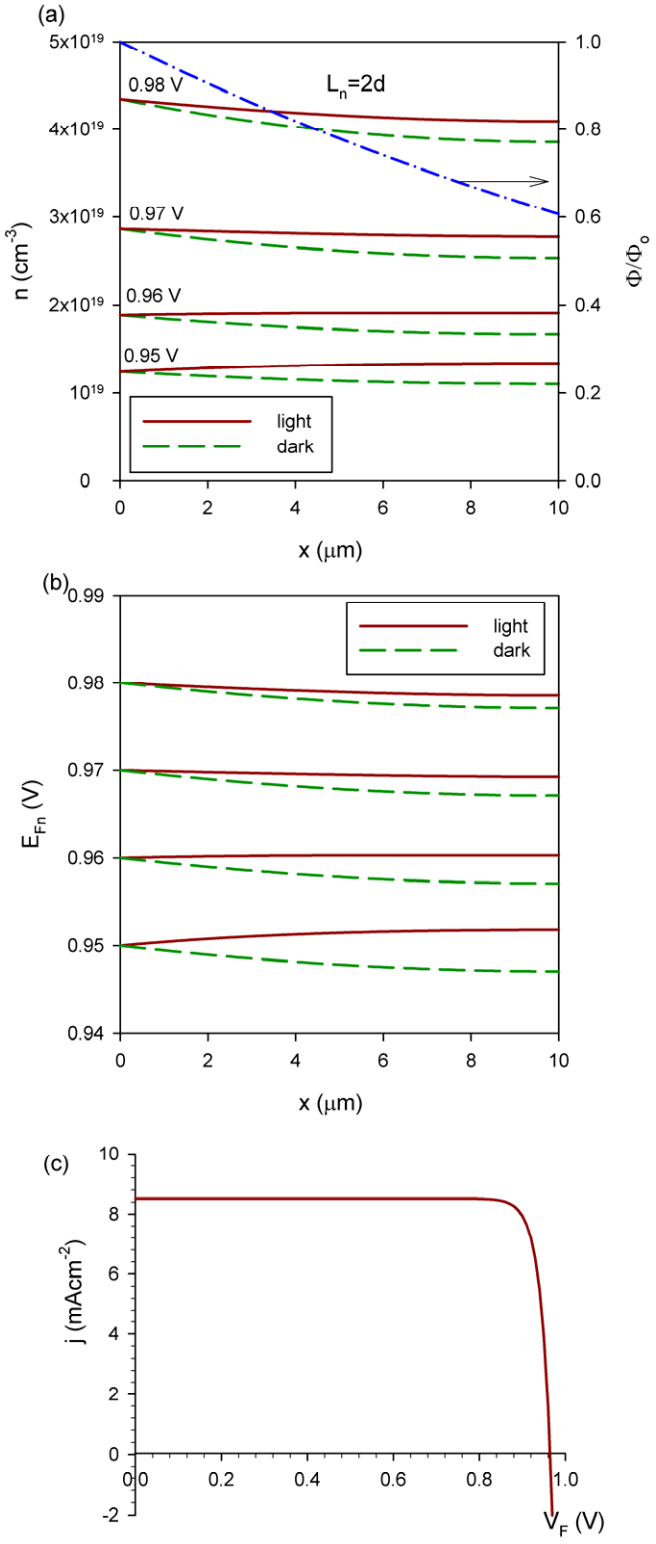
(a)
5x10^19
4x10^19
3x10^19
2x10^19
10^19
0
n (cm^-3)
1.0
0.8
0.6
0.4
0.2
0.0
Φ/Φ_o
0.98 V
0.97 V
0.96 V
0.95 V
L_n=2d
light
dark
0
2
4
6
8
10
x (μm)
(b)
0.99
0.98
0.97
0.96
0.95
0.94
E_Fn (V)
light
dark
0
2
4
6
8
10
x (μm)
(c)
10
8
6
4
2
0
-2
j (mAcm^-2)
0.0
0.2
0.4
0.6
0.8
1.0
V_F (V)

Fig. SI 3