Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A

Supporting Information

for

Overcoming interface losses in organic solar cells by applying low temperature, solution processed aluminum-doped zinc oxide electron extraction layers

Tobias Stubhan, Ivan Litzov, Ning Li, Michael Salinas, Matthias Steidl, Gerhard Sauer, Karen Forberich, Gebhard J. Matt, Marcus Halik and Christoph J. Brabec

S1. Parameter set for PC1D simulation

Software available at http://www.pv.unsw.edu.au/info-about/our-school/products-services/pc1d

Active layer:

Thickness: 0.16 µm

Material modified from program defaults

Fixed electron mobility: $3*10^{-3}$ cm²/Vs

Fixed hole mobility: $8*10^{-4}$ cm²/Vs

Dielectric constant: 3

Band gap: 0.85 eV

Intrinsic conc. at 300 K: $1*10^{12}$

Refractive index: 1.8

Absorption coeff. from internal model

No free carrier absorption

P-type background doping: $1*10^{15}$ cm-3

No front diffusion

No rear diffusion

Bulk recombination: $T_n = T_p = 5$ µs

No Front-surface recombination

No Rear-surface recombination

Electron extraction layer:

Thickness: variable, 0.03-1.25 µm

Material modified from program defaults

Fixed electron mobility: $1*10^{-3}$ cm²/Vs

Fixed hole mobility: $1*10^{-3}$ cm²/Vs

Dielectric constant: 25

Band gap: 1.3 eV

Intrinsic conc. at 300 K: $1.1*10^{8}$ cm^{-3}

Refractive index: 2

Absorption coeff. from internal model

No free carrier absorption

N-type background doping: variable, $6.25*10^{16}$ - $6.25*10^{18}$ cm^{-3}

No front diffusion

No rear diffusion

Bulk recombination: $T_n = 1*10^{6}$ µs, $T_p = 5$ µs

No Front-surface recombination

No Rear-surface recombination

Excitation:

Excitation mode: Transient, 200 timesteps

Temperature: 300 K

Base circuit: Sweep from 0 to 0.562 V, Step at t = 0

Collector circuit: Zero

Primary light source enabled

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Constant intensity: 0.1 W cm^{-2}

Spectrum AM 1.5 G

Secondary light source disabled

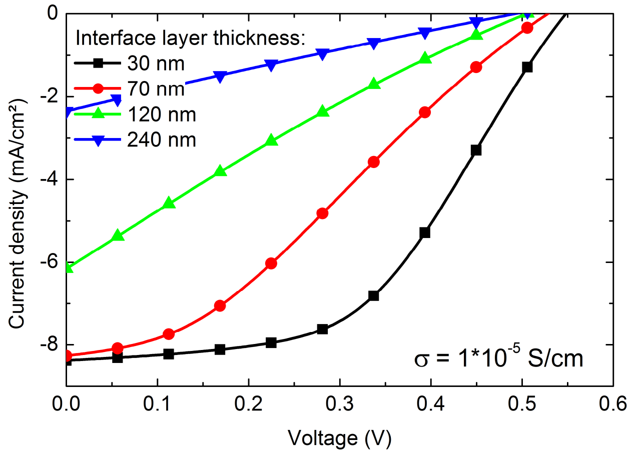

Figure S2. Low conductive interface layer induces s-shape behavior in the j-V characteristics.

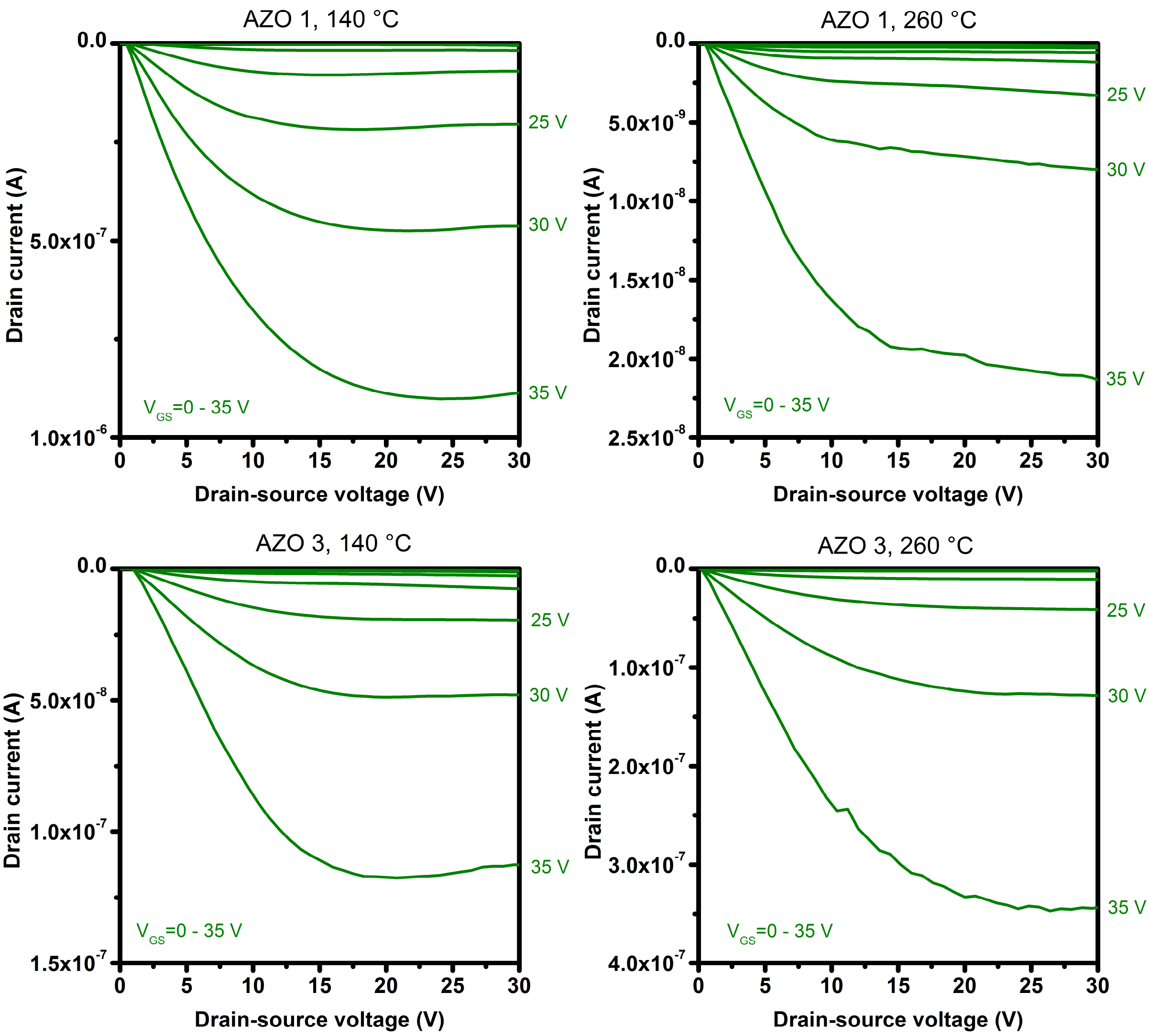

Figure S3. Output characteristics of the transistor devices with different AZO layers.

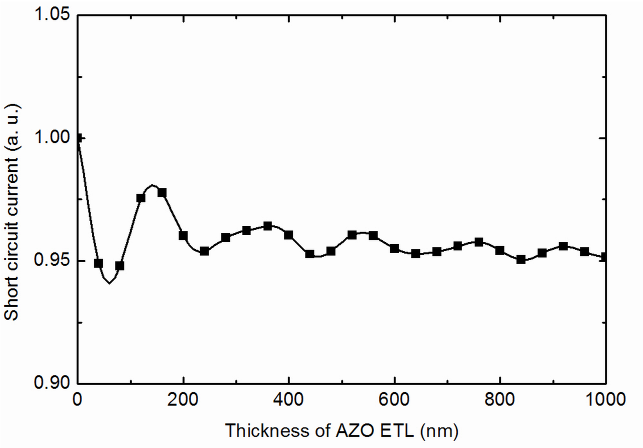

Figure S4. Optical simulation of the short circuit current with varying AZO EEL from 0-1000 nm. The simulated layer stack was Glass/ITO(400 nm)/AZO(0-1000 nm)/P3HT:PCBM(100 nm)/PEDOT:PSS(40 nm)/Ag(100 nm).

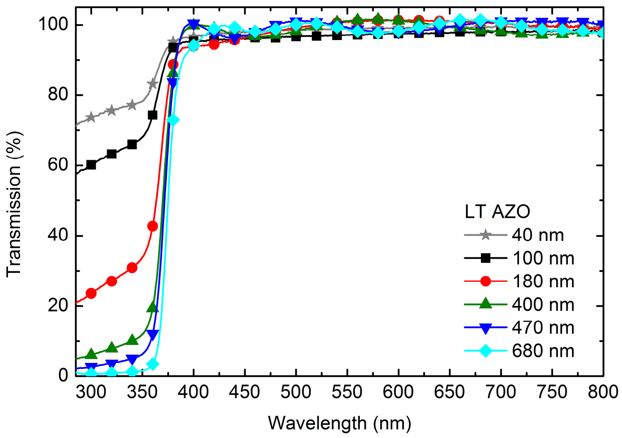

Figure S5. Optical transmission of LT AZO films with thicknesses from 40 to 680 nm excluding the glass substrate. The transmission is very high for all thicknesses in the visible wavelengths.