Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics.

Supporting Information

Temperature Role in the Recombination Reaction on Dye-Sensitized Solar Cells

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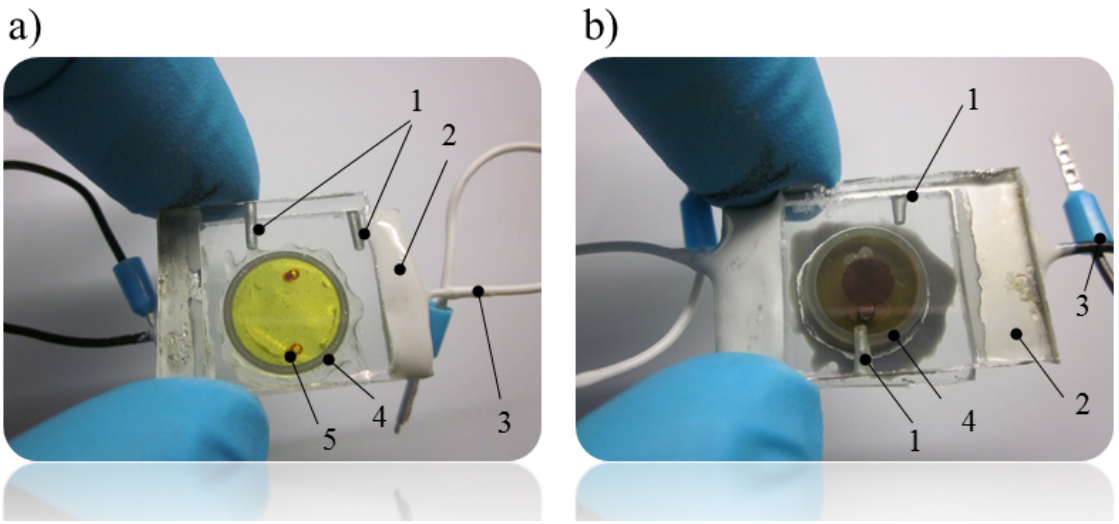

Figure S1. Photographs of the (a) laser sealed half-cells and (b) dye-sensitized solar cells: 1 – drilled hole for temperature measurement; 2 – electrical contact; 3 – electrical terminal; 4 – glass frit sealing; 5 – electrolyte filling hole.

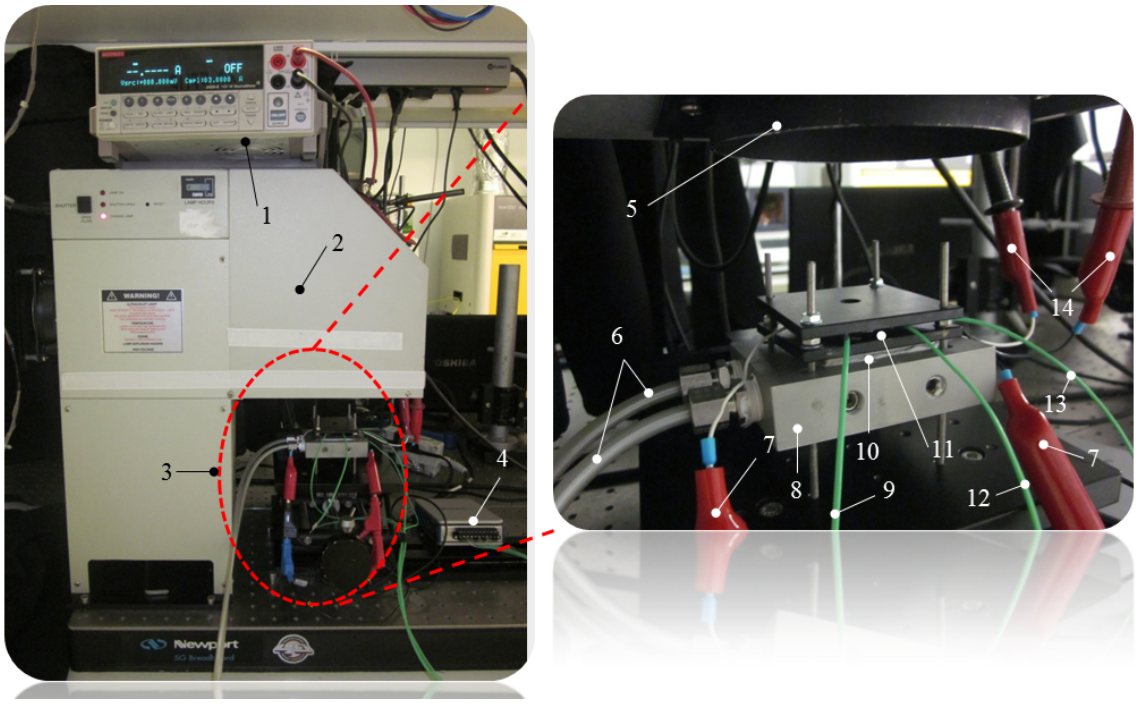

Figure S2. Experimental setup used for temperature control of an under illumination DSC between -5 °C and 105 °C. 1-Keithley DC supply; 2-Newport solar simulator; 3-temperature control unit; 4- NI acquisition board; 5- solar simulator ; 6- cooling fluid lines; 7- DSC electrical connections to autolab potentiostat; 8- aluminum slab with drilled thermal fluid circuit; 9 –thermocouple T_2 ; 10 – peltier device; 11 – DSC; 12- thermocouple T_1 ; thermocouple T_3; 14 – electrical connections from peltier device to Keithley DC supply

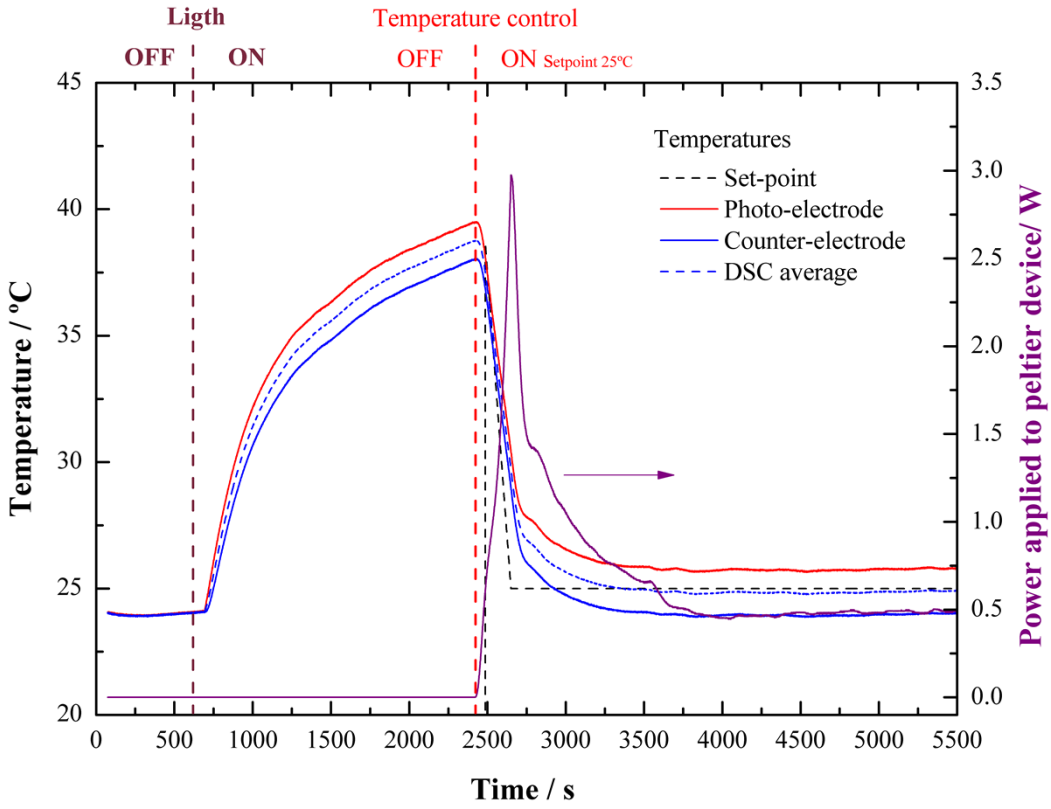

Figure S3. Temperature measurements of an illuminated DSC (100mW·cm^{-2}, AM 1.5); with and without temperature control.

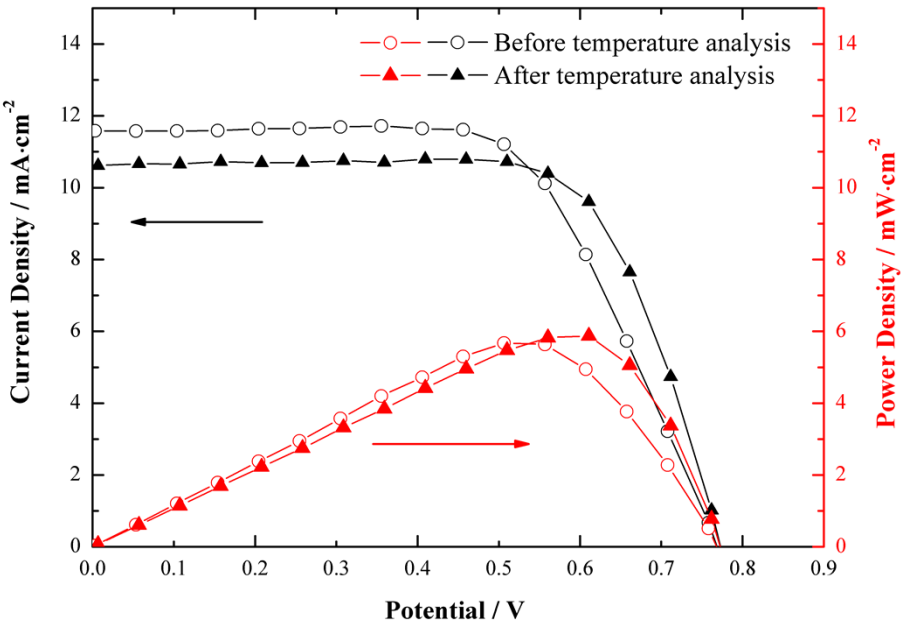

Figure S4. *I-V* and power density curves for a DSC before and after sustaining the temperature analysis range from 0 to 100 ºC. Lines were added for readability.

Table S1. Performance parameters, obtained at 25ºC, of samples that underwent the temperature analysis, before and after the tests.

Parameter	Before temperature tests	After temperature tests
V_{OC} / V	0.773	0.777
J_{SC} / mA.cm^{-2}	11.3	10.8
MMP / mW.cm^{-2}	5.72	5.95
FF	0.655	0.712
η / %	5.83	6.07

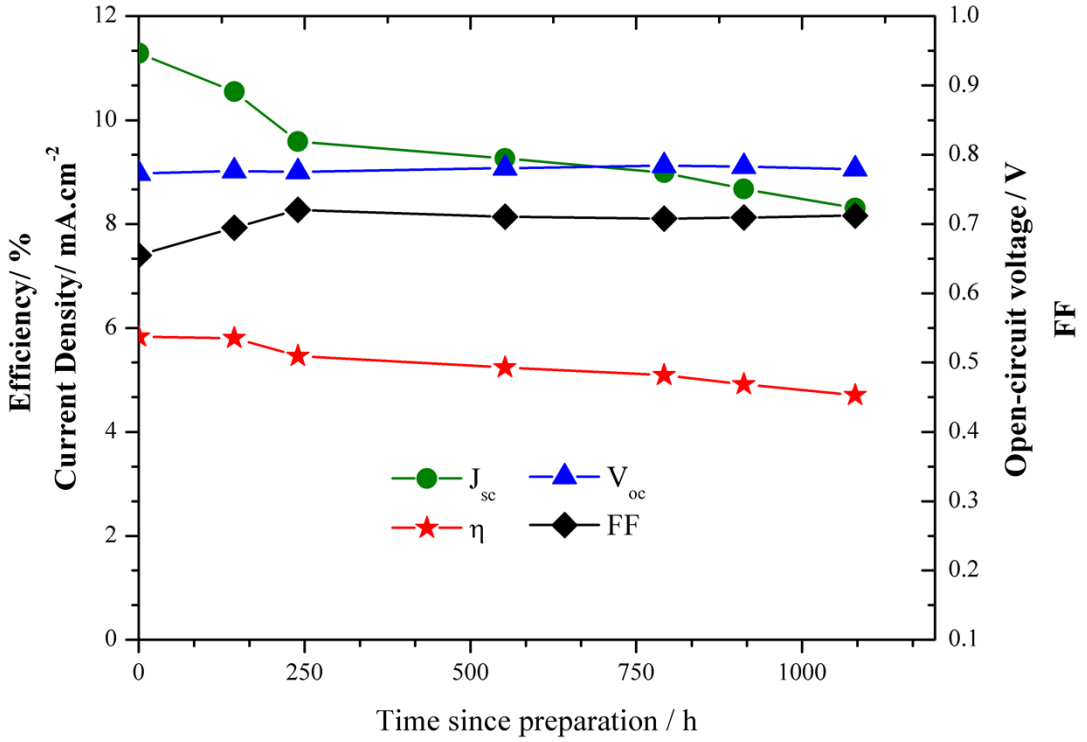

Figure S5. Performance parameters *vs* time since preparation of samples that underwent the temperature analysis (0 to 100ºC): V_{OC} – open circuit voltage; J_{SC} – short circuit current density; *FF* – fill factor; η - photo conversion efficiency. Lines were added for readability.

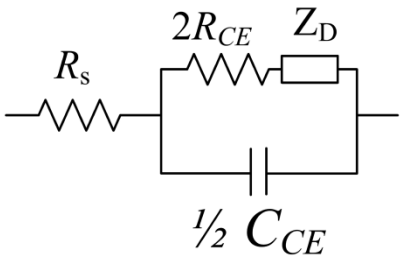

Figure S6. Electrical analogue used for fitting the electrochemical impedance spectra of half-cells. R_s – series resistances ; R_{CE} – charge transfer at catalytic interface; C_{CE} double layer capacitance at catalytic interface; Z_d- Nernst diffusion within electrolyte

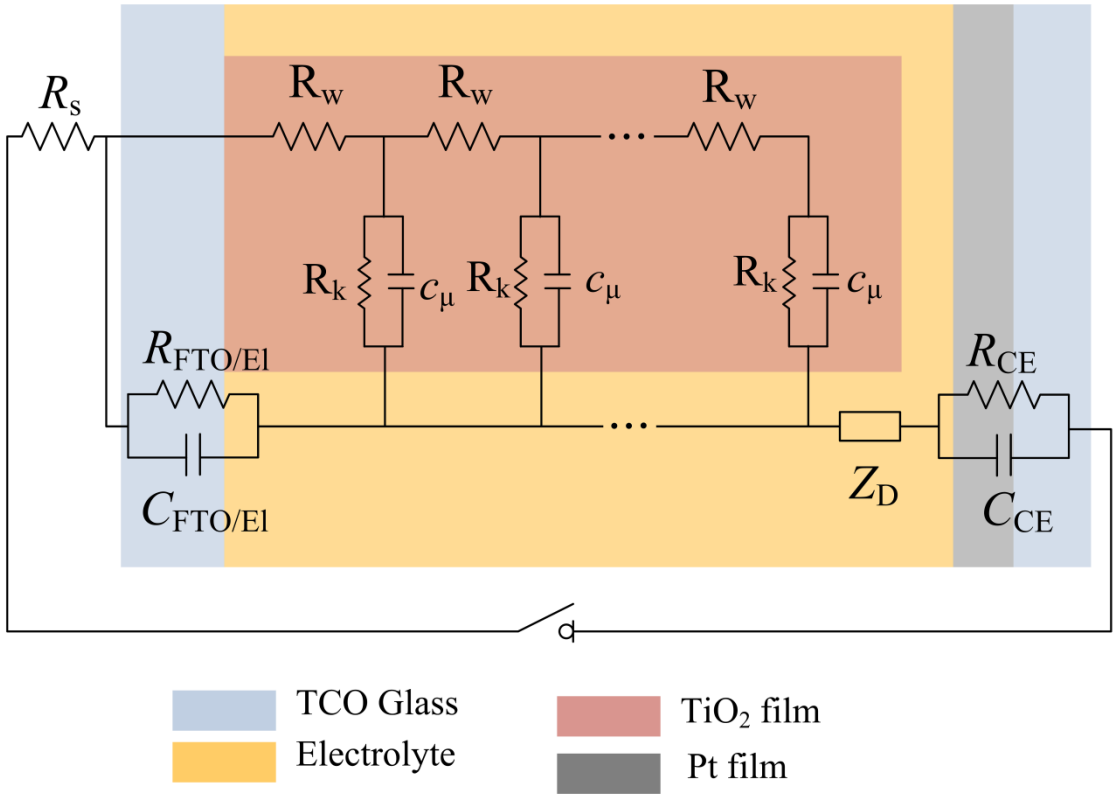

Figure S7. Transmission line model used to fit EIS experimental data of DSCs. R_s – series resistances; $R_{TCO/EL}$ – charge transfer resistance at exposed TCO/electrolyte interface; $C_{TCO/EL}$ double layer capacitance at exposed TCO/electrolyte interface; R_k – recombination resistance; R_w – transport resistance; c_μ – chemical capacitance; Z_d- Nernst diffusion within electrolyte; R_{CE} – charge transfer at platinum/TCO interface; C_{CE} double layer capacitance at the platinum/TCO interface

Table S2. Performance parameters at 25ºC of the five batches of DSCs presented in Figure 12.

	Batch nº				
Parameter	k_1	k_2	k_3	k_4	k_5
$V_{OC,25ºC}$ / V	0.719±0.003	0.727±0.004	0.734±0.005	0.739±0.005	0.777±0.008
$J_{SC,25ºC}$ / mA.cm^{-2}	7.67±0.40	9.03±0.05	9.95±0.43	10.27±0.45	11.53±0.41
$FF_{,25ºC}$	0.641±0.046	0.632±0.046	0.665±0.012	0.645±0.032	0.638±0.035
$\eta_{,25ºC}$ / %	3.60±0.08	4.23±0.31	4.86±0.12	4.99±0.18	5.80±0.16