Supplementary material

for

Towards thermal stability of dye-sensitized solar cells for wavelength-selective greenhouse using the polymorphism of the light scattering layer

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SPICE model generation steps:

To generate the SPICE model of solar cells, the following steps are required according to our method:

i. Get IV curves at different temperatures. For our cells we got IV curves at temperatures in range 20-60 °C with step of one degree Celsius. During IV curve measurements, the environment and solar cell temperature are also monitored.
ii. Process data. The measurements are affected by noise, so to get rid of them we use „Smoothing Splines" interpolant method.
iii. Estimate series and parallel resistors. In this step we obtain minimum and maximum boundaries for resistor values which will be used to restrict solution search field for algorithm.

$$R_s = -\frac{dV}{dI}\Big|_{V=V_{oc}}$$

$$R_p = -\frac{dV}{dI}\Big|_{I=I_{sc}}$$

iv. To find those 5 parameters of models we used Global Optimization Toolbox from MATLAB set to use particle swarm intelligence.

v. After that, for each parameter we find a mathematical equation to model de temperature influence on it. The mathematical equations are use then to generate spice model

vi. Evaluate model to find the errors.