Electronic Supplementary Material (ESI) for RSC Advances

Towards green, efficient and durable quasi-solid dye-sensitized solar cells integrated with a cellulose-based composite gel-polymer electrolyte

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Supporting information

Summary

1) Observed vs Predicted plot

This is the plot of the observed values vs the fitted or predicted values. Plots with the points close to straight line indicate good models.

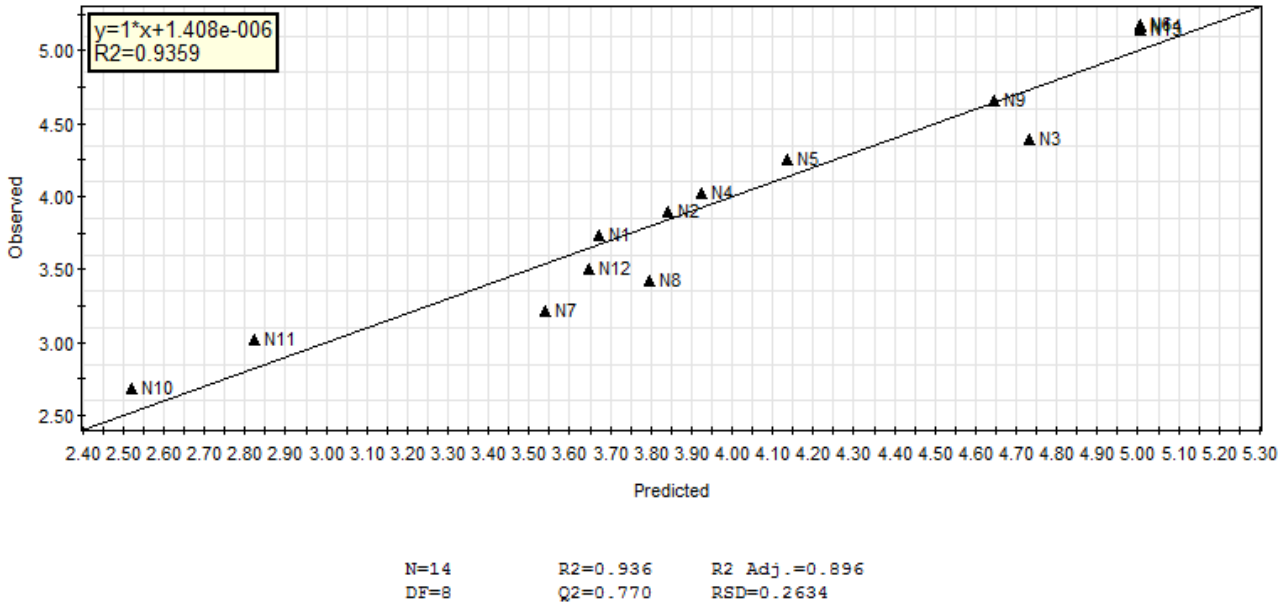

Fig. S1 Observed vs Predicted plot for the D-optimal DoE

2) Normal probability plot of residuals

The residuals are plotted on a cumulative normal probability scale. This plots makes it easy to detect:

- Normality of the residuals: if the residuals are normally distributed, the points on the probability plot follow close to a straight line
- Outliers: these are points deviating from the normal probability line, and having large absolute values of studentized residuals, i.e. larger than 4 standard deviation indicated by red lines on the plot.

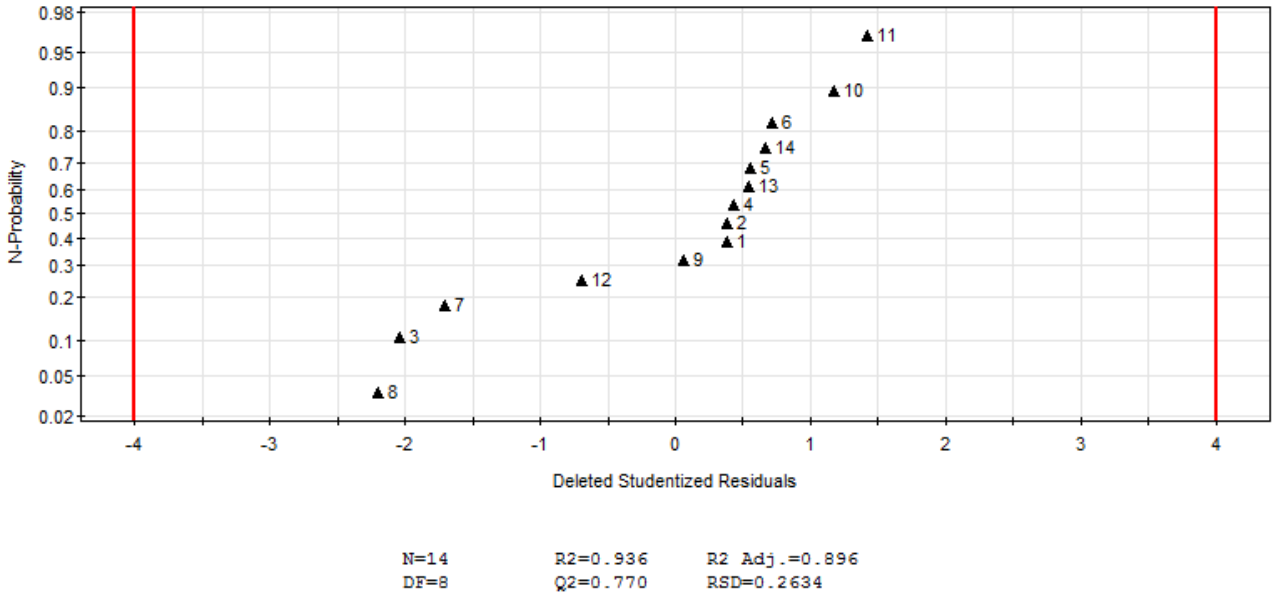

Fig. S2 Normal probability plot of residuals

3) EIS measurements

CMC, with its $-CH_2COO^-$ moieties, can attach to the surface of the TiO_2 electrode and reduce the interaction between the electrons and I_3^- ions, thereby decreasing the rate of recombination. In this way, the trap states of the TiO_2 electrode will be further shielded, thus leading to an increased recombination resistance at the TiO_2/electrolyte interface, as observed in preliminary studies of electrochemical impedance spectroscopy. In fact, the modeling of EIS spectra evidences an initial decrease of the charge-transfer resistance related to electron recombination (central arc of the impedance spectra), as emphasized in Fig. S3, in the presence of a CMC:PEO ratio of 0.09.

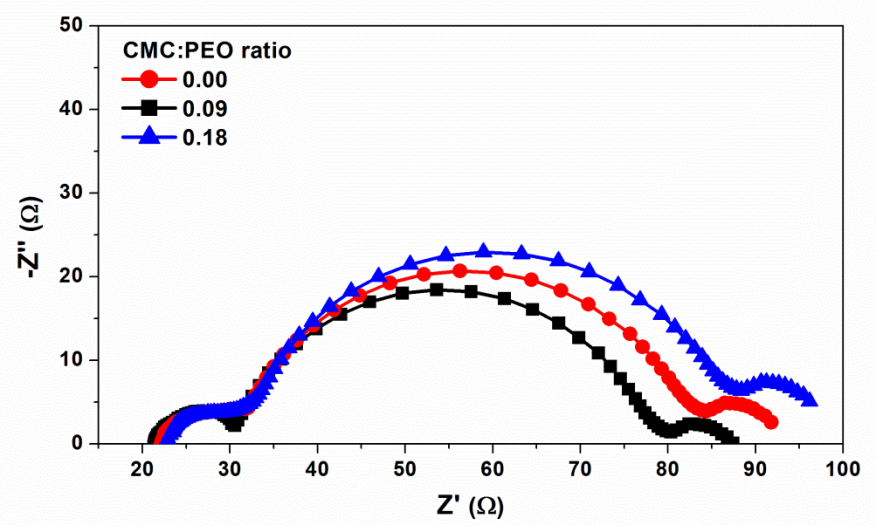

Fig. S3 Impedance spectra (collected under dark, at V_{oc}) for DSSCs assembled with different CMC:PEO weight ratios, in the presence of 55 wt% of liquid electrolyte.

4) I-V measurements under dark

From I-V measurements collected under light, we observed that in the presence of high amounts of CMC (CMC:PEO ≥ 0.18), V_{oc} values begin to decrease. This fact seems to be ascribed to the markedly decrease in J_{sc} values (and and therefore also in the ionic conductivity) showed in Fig. 4A of the manuscript. In fact, the lower electrolyte conductivity would favor charge recombination losses arising from electrons in the TiO_2 CB/trap states and electrolyte acceptors, thus decreasing V_{oc}. Clear evidence for this behavior may be provided by *J-V* curves measured in the dark (Fig. S4), since DSSCs based on the gel-polymer electrolyte with high CMC content exhibit higher dark current values (0.27 > 0.18 > 0.09).

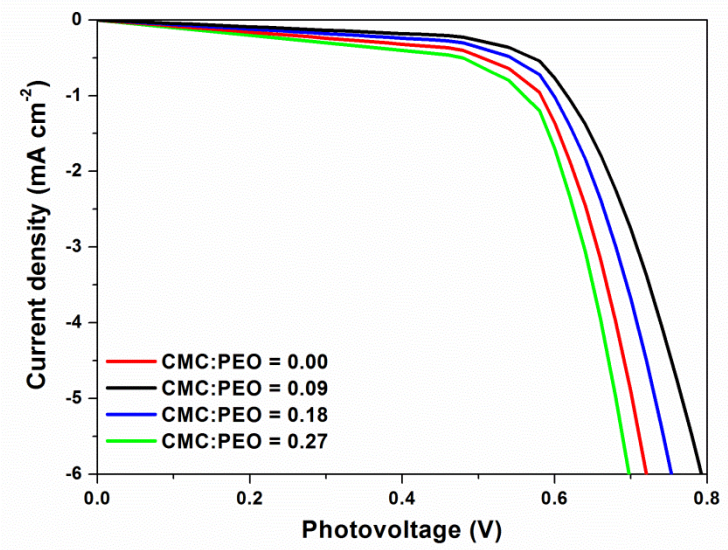

Fig. S4 Dark currents for the DSSCs assembled with different CMC:PEO weight ratios, in the presence of 55 wt% of liquid electrolyte.