Electronic supplementary information

Influence of the electrolyte cation in organic dye-sensitized solar cells: lithium *versus* dimethylimidazolium

Renzhi Li,[ab] Daxing Liu,[ab] Difei Zhou,[ab] Yushuai Shi,[ab] Yinghui Wang[a] and Peng Wang*[a]

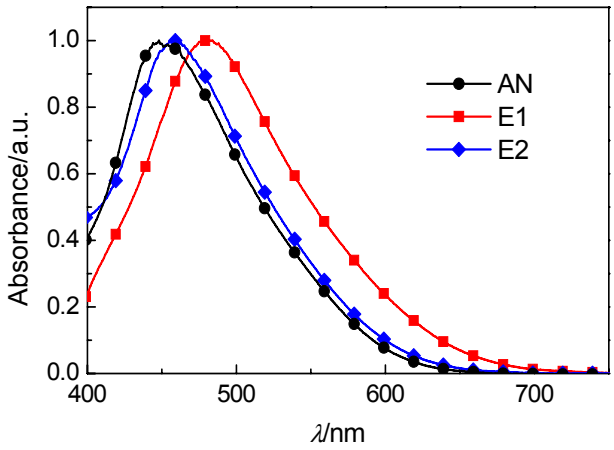

Fig. S1 Electronic absorption spectra of a **C218**-coated titania films immersed in AN, **E1** or **E2**. Film thickness: 2 μm.

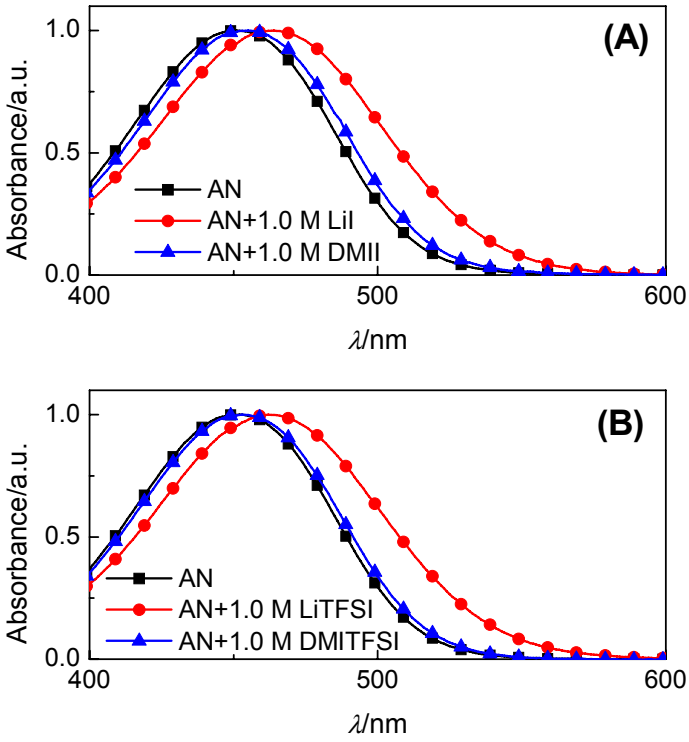

Fig. S2 Electronic absorption spectra of the **C218** aldehyde precursor. The aldehyde concentration was 10 μM.

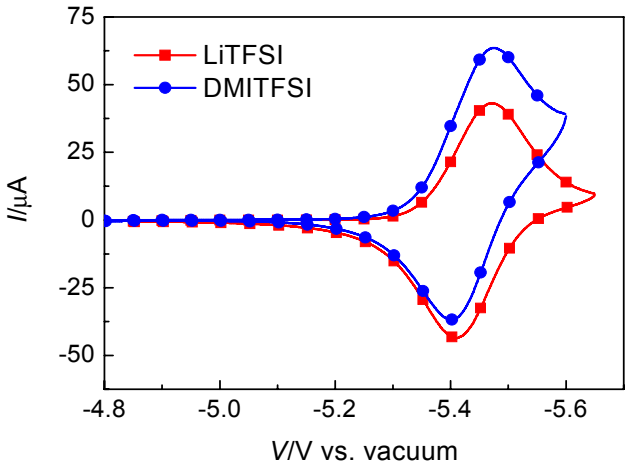

Fig. S3 Cyclic voltammographs of a **C218**-coated TiO_2 film immersed in electrolytes composed of 1.0 M LiTFSI and DMITFSI in AN, respectively. Scan rate: 20 mV s^{-1}.

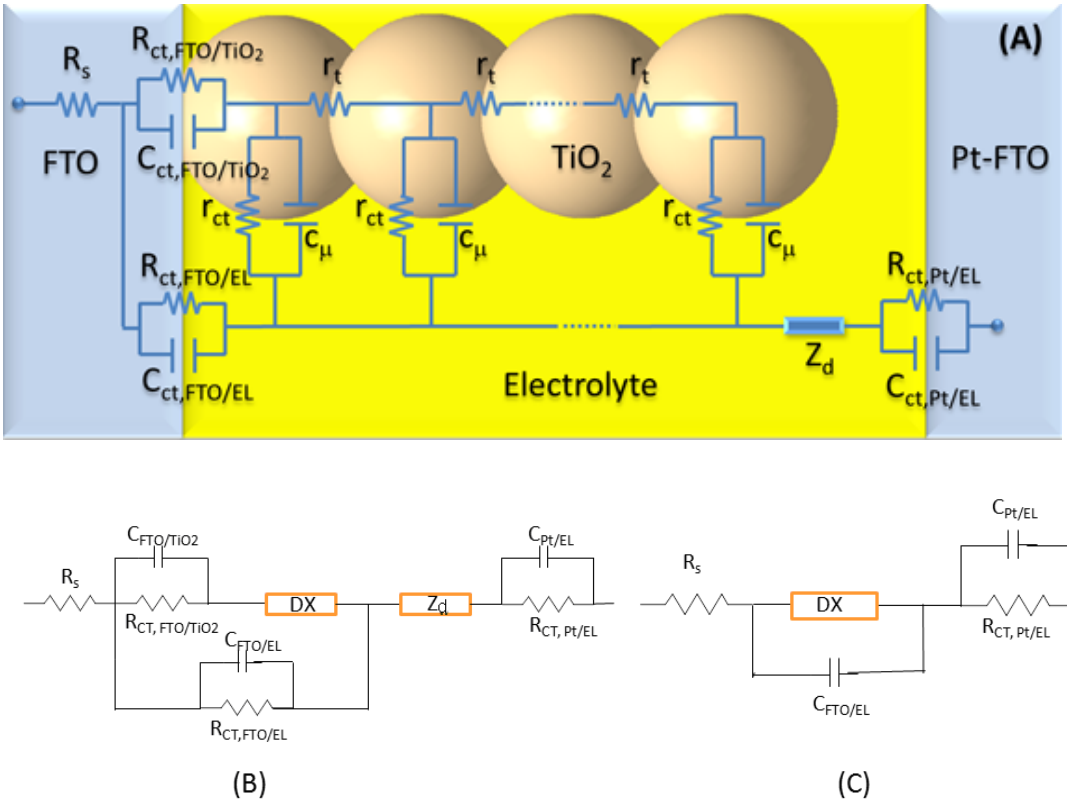

Fig. S4 (A) The equivalent circuit proposed by Bisquert *et al*. for DSCs, primarily incorporates the transmission line model which depicts the physical electronic behavior in the mesoporous titania film and at the titania/electrolyte interface. In addition, other interfacial charge transfer/transport channels are also included. R_s is the series resistance, primarily related to the sheet resistance of FTO glass and contact resistance of the cell circuit. $R_{ct,FTO/TiO2}$ and $C_{ct,FTO/TiO2}$ are the charge transfer resistance and the capacitance at FTO/TiO_2 contact; $R_{ct,FTO/EL}$ and $C_{ct,FTO/EL}$ are the charge-transfer resistance and the corresponding double-layer capacitance at the uncovered FTO/electrolyte interface; r_t depicts the resistance of electrons traversing through the TiO_2 film; r_{ct} is the charge-transfer resistance of charge recombination with triiodide in electrolytes; c_μ is the chemical capacitance at the TiO_2/electrolyte interface, which is replaced by a constant phase element (CPE) in the practical

analysis taking into account of the roughness of TiO_2 film; Z_d describes the Warburg impedance of redox species; $R_{ct,Pt/EL}$ and $C_{ct,Pt/EL}$ are the charge-transfer resistance and double-layer capacitance at the counter electrode/electrolyte interface; $C_{ct,Pt/EL}$ is treated with a CPE. (B) A refined equivalent circuit wherein DX represents an extended element which embodies the typical transmission line model shown in circuit A, containing apparent parameters of R_t, R_{ct} and C_μ. (C) A simplified equivalent circuit virtually employed in our modeling with the impedance software Z-view software (v2.80, Scribner Associates Inc.). In practical impedance measurements, the physical feature of Z_d (Warburg impedance of redox species) out of our present research focus was not recorded because of the requirement of an extremely low perturbation frequency, i.e. a very long tracking time. Thereby the Z_d element is not incarnated here. In our cell configuration, the ohmic contact between FTO and TiO_2 hardly affects the electron collection so that this interface is treated as short circuited. The standard TiO_2 film used in our group considerably inhibits the charge transfer at the FTO/electrolyte, and thus it is reasonable to treat $R_{FTO/EL}$ as open circuited. Through a systematic comparison of different equivalent circuits, we have found that this simplified circuit can give satisfactory fittings of EIS data.

Table S1 Parameters derived from mathematical fittings of chemical capacitance and apparent electron lifetime.

electrolyte	E1	E2
N_t/cm^{-3}	2.76×10^{19}	3.41×10^{19}
T_c/K	958	802
α^a	0.31	0.37
γ	0.48	0.56
k_0/cm$^{-3(1-\gamma)}$ s^{-1}	3.9×10^{9}	2.8×10^{10}

[a]The parameter α was calculated with T=298 K.