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Dispelling clichés at the nanoscale: the true effect of polymer electrolytes on the performance of dye-sensitized solar cells

Federico **Bella**[*1,2], Adriano **Sacco**[2], Giulia **Massaglia**[1,2], Angelica **Chiodoni**[2], Candido Fabrizio **Pirri**[1,2], Marzia **Quaglio**[2]

1) *Department of Applied Science and Technology - DISAT, Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129 Torino, Italy*
2) *Center for Space Human Robotics @Polito, Istituto Italiano di Tecnologia, Corso Trento 21, 10129 Torino, Italy*

[*] Corresponding author: Federico Bella (federico.bella@polito.it ; +39 0110904638; Contact details: affiliation 1)

APPENDIX A

CHARACTERIZATION OF THE BEMA/PEGMA UV-CROSSLINKED MATRIX

The gel content of the UV-cured polymer was 97%, thus indicating the absence of any extractable monomer or oligomer, and the consequent formation of an adequately crosslinked network. The thermal stability of the polymer membrane was assessed by TGA and the resulting thermogram is reported in Fig. S1. It shows a one-step weight loss degradation process above 300 °C: this value is very high, especially if considering that, generally, the operating temperature of DSSCs does not exceed 70 °C. As regards DSC characterization, the obtained trace is reported in Fig. S2. The UV-crosslinked polymer showed a T_g value of –54 °C, thus it is in the rubbery state under standard DSSC operating conditions, facilitating ions diffusion and avoiding phase transitions during device operation.

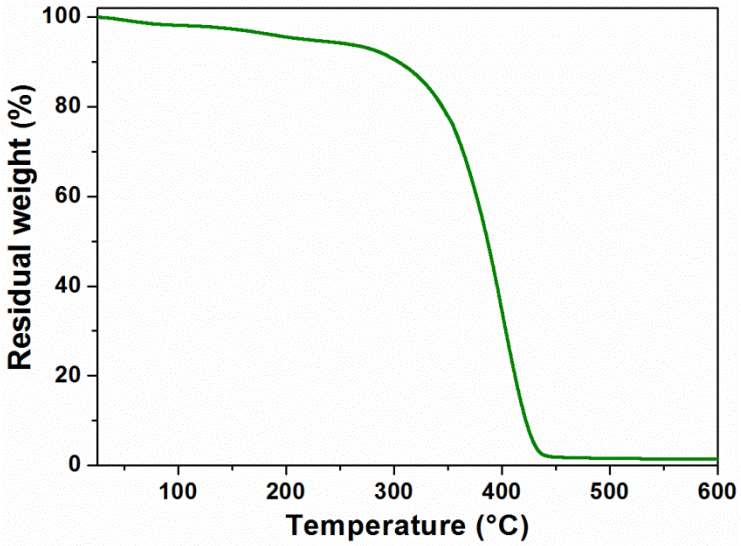

Fig. S1 TGA measurement, under flowing nitrogen, in the temperature range between 25 °C and 600 °C, of the UV-cured BEMA/PEGMA polymer network.

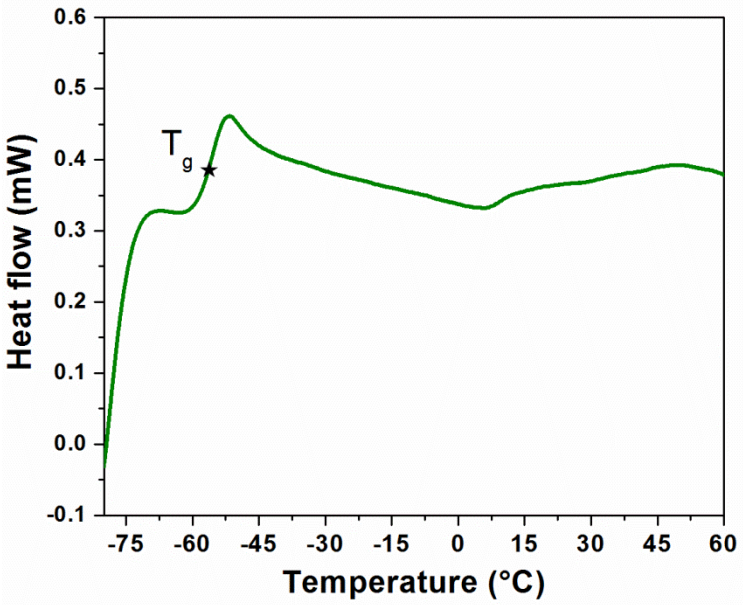

Fig. S2 DSC measurements, under flowing nitrogen, in the temperature range between –75 °C and 60 °C, of the UV-cured BEMA/PEGMA polymeric network. The glass transition temperature (T_g) was evaluated at the midpoint of the heat capacity change observed in the DSC trace during the transition from glassy to rubbery state

MICROFLUIDIC CELL ARCHITECTURE

DSSCs were fabricated employing a microfluidic architecture developed in our laboratory, and illustrated in Fig. S1. It consists of a poly(dimethylsiloxane) (PDMS) thin membrane reversibly sealed between the two electrodes, with an external poly(methylmethacrylate) (PMMA) clamping system. The cell filling with the redox mediator solution is performed with a syringe connected to the microfluidic housing ports and the right self-confinement of the electrolyte during the cell assembling procedure is guaranteed by the structure of the microchannels which connected the ports and the chamber. Copper foils (50 µm-thick) were used as electrical contacts with FTO.

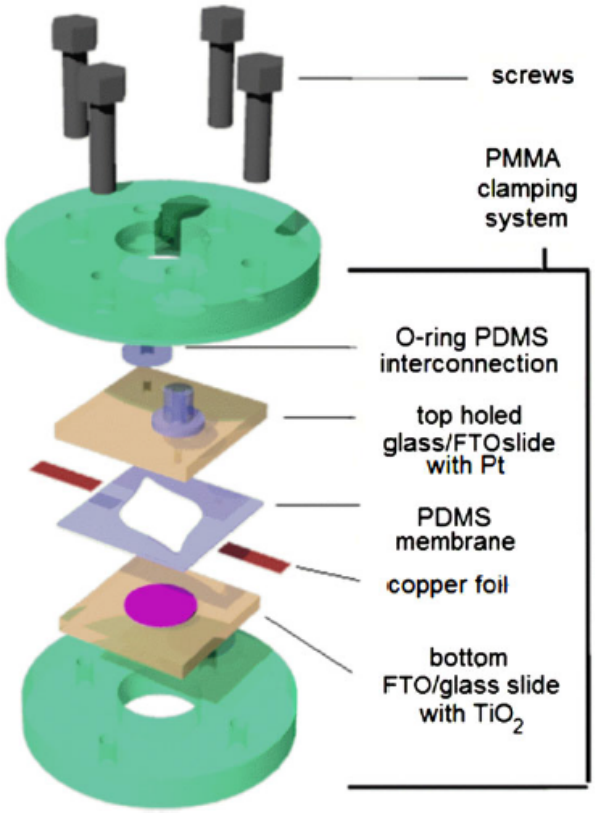

Fig. S3 Microfluidic architecture used for the assembly of DSSC. Reprinted with permission from [1].

EVALUATION OF THE POLYMER ELECTROLYTE PENETRATION

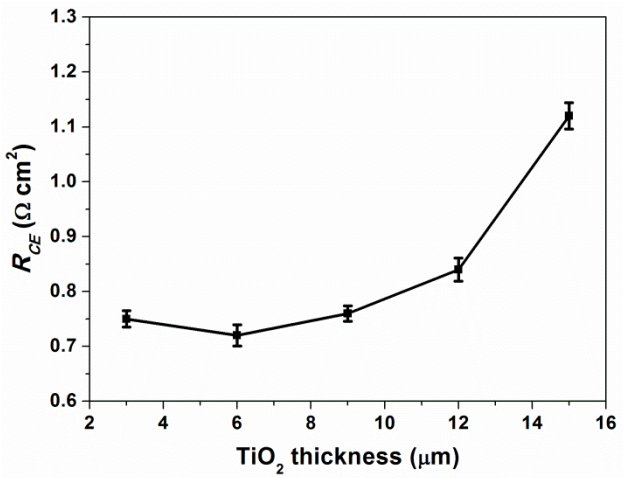

Fig. S4 Effect of the TiO_2 photoelectrode thickness on the charge transport resistance at the Pt/electrolyte interface in symmetrical cells.

J-V CHARACTERISTICS

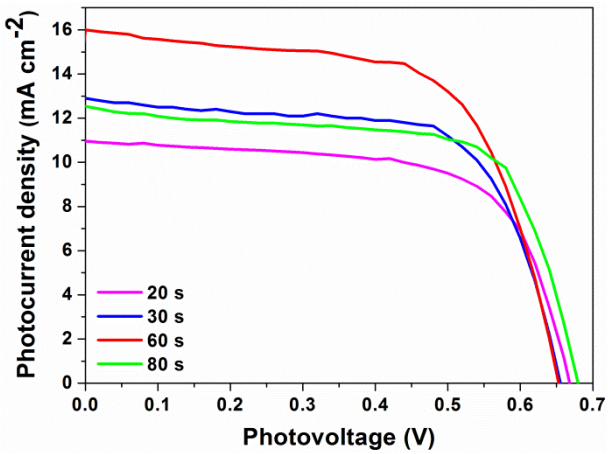

Fig. S5 Photocurrent-photovoltage curves under 1 sun irradiation of DSSCs assembled with electrodeposited/photopolymerized polymer electrolytes, as a function of the electrodeposition time.

[1] Sacco, A.; Lamberti, A.; Pugliese, D.; Chiodoni, A.; Shahzad, N.; Bianco, S.; Quaglio, M.; Gazia, R.; Tresso, E.; Pirri, C. F. *Appl. Phys. A* **2012**, *109*, 377