Electronic Supplementary Material

Controlling Electrode Spacing by Polystyrene Microspheres Spacers for Highly Stable and Flexible Transparent Supercapacitors

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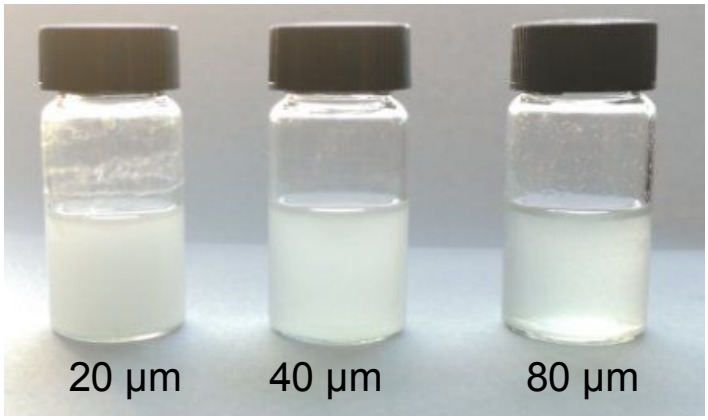

Figure S1 Digital photos of PVA-LiCl gel electrolytes containing different sizes PS microspheres of 20, 40 and 80 μm.

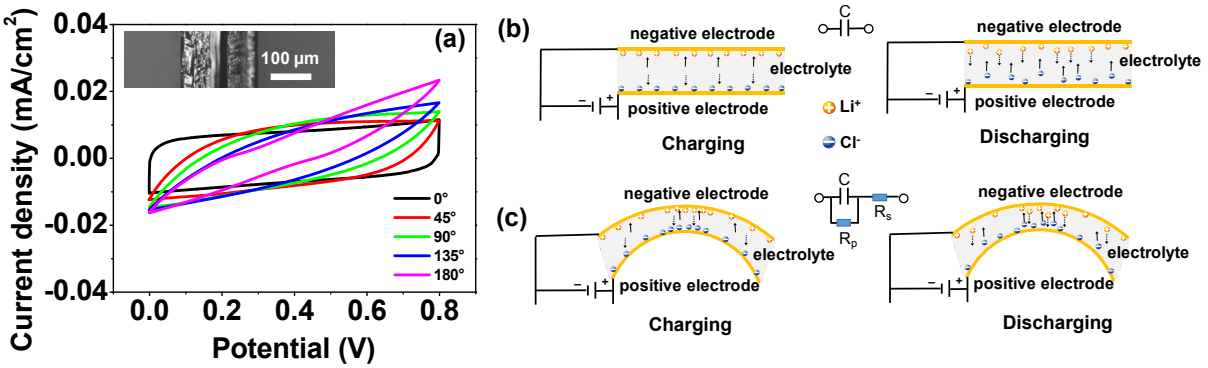

Figure S2 (a) CV curves of the ITO-PET/SWCNTs/PVA-LiCl /SWCNTs/ITO-PET sandwich-like supercapacitors at different bending angles with a scan rate of 100 mV/s. The areal capacitances of the device at bending angles of 0°, 45°, 90°, 135° and 180° are calculated to be 148.01, 139.41, 127.96, 103.63 and 76.18 μF/cm^2, respectively. The inset is the cross-sectional optical microscopy image devices under normal condition. (b, c) Schematic illustration of the charging and discharging processes of devices under normal and bending conditions.

The charge and discharge process of PS microspheres-free device under normal and bending operation is demonstrated in Figure S2b and 2c, respectively. Under normal operation, the supercapacitors (C) have even electrode spacing and uniform electrode surface. The process of charging/discharging for the supercapacitors is demonstrated in Figure S2b. For the PS microspheres-free device under bending operation, supercapacitors with uneven electrode spacing are obtained, leading to the extra internal resistance between the electrodes and sheet resistance on the surfaces of electrodes, which are acted as parallel resistor (R_p) and series resistor (R_s) in the circuit, respectively. Hence, the CV curves are changed from rectangle to blunt and slanted shapes, resulting in the loss of capacitance.

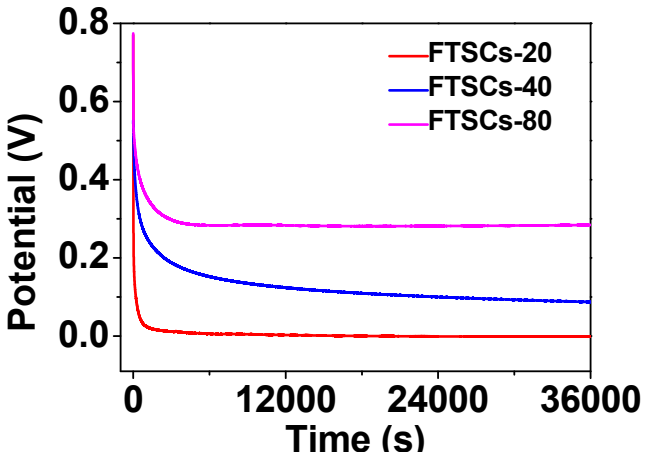

Figure S3 Self-discharge curves of FTSCs-20, FTSCs-40 and FTSCs-80.

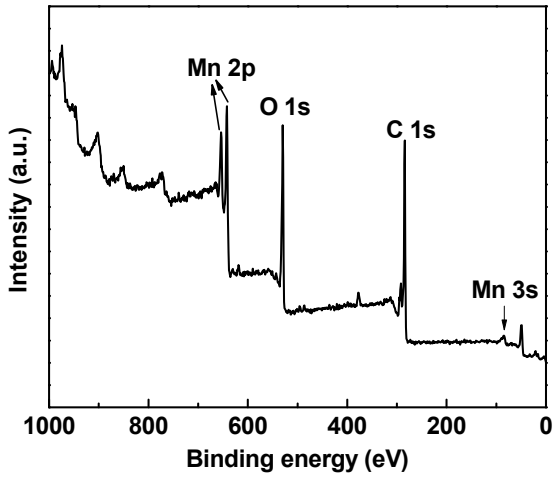

Figure S4 The survey scan XPS spectrum of MnO2-MWCNTs.

Table. S1 Performance of flexible transparent supercapacitors based on SWCNTs and MnO_2 materials

Active materials	Transmittance @ 550 nm (%)	Areal capacitance (mF/cm^2)	Reference
SWCNTs	92	0.552	[1]
SWCNTs	75	0.0475	[2]
SWCNTs	57.4 61.5	0.121 0.104	Present work
Islandlike MnO_2 Arrays	44	4.73	[3]
MnO_2@Ni network	80.82	43	[4]
MnO_2@Au nanofibers	79	2.07	[5]
MnO_2@Au−Ni mesh	61.1	2.12	[6]
Au/MnO_2 network	63	0.66	[7]
Au@MnO_2 core-shell nanomesh	36	0.795	[8]
MnO_2-MWCNTs	52.3	1.7	Present work

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