

Supporting Information

Effect of Zwitterionic Additive on Electrode Protection through Electrochemical Performances of Anatase TiO₂ Nanotube Array Electrode in Ionic Liquid Electrolyte

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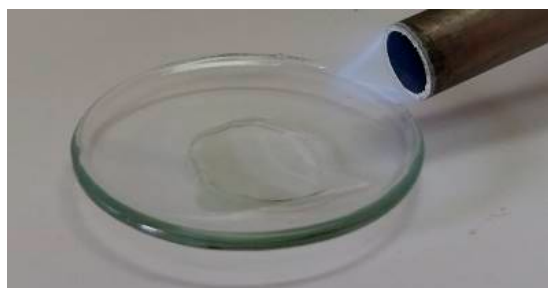
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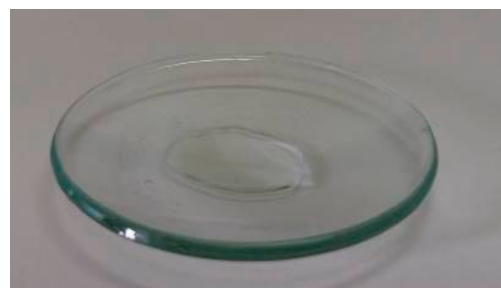
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Table S1. Summarized the identification results and normalized ion currents for investigated sample of synthesized zwitterionic compound $C_1C_4imSO_3$.

m/z fragment	Normalized ion current for compound $C_1C_4imSO_3$
14	$1 \cdot 10^{-9}$
16	$5 \cdot 10^{-10}$
17	$2 \cdot 10^{-9}$
18	$8 \cdot 10^{-9}$
28	$1 \cdot 10^{-8}$
32	$5 \cdot 10^{-9}$
36	$4 \cdot 10^{-9}$
44	$1 \cdot 10^{-10}$
48	$2 \cdot 10^{-10}$
64	$2 \cdot 10^{-10}$



(a)



(b)

Figure S1. Flammability test pictures of $LiTFSI/C_2C_2imTFSI/C_1C_4imSO_3$ when is: **a)** exposed to flame and **b)** after exposure of 120 s to flame.

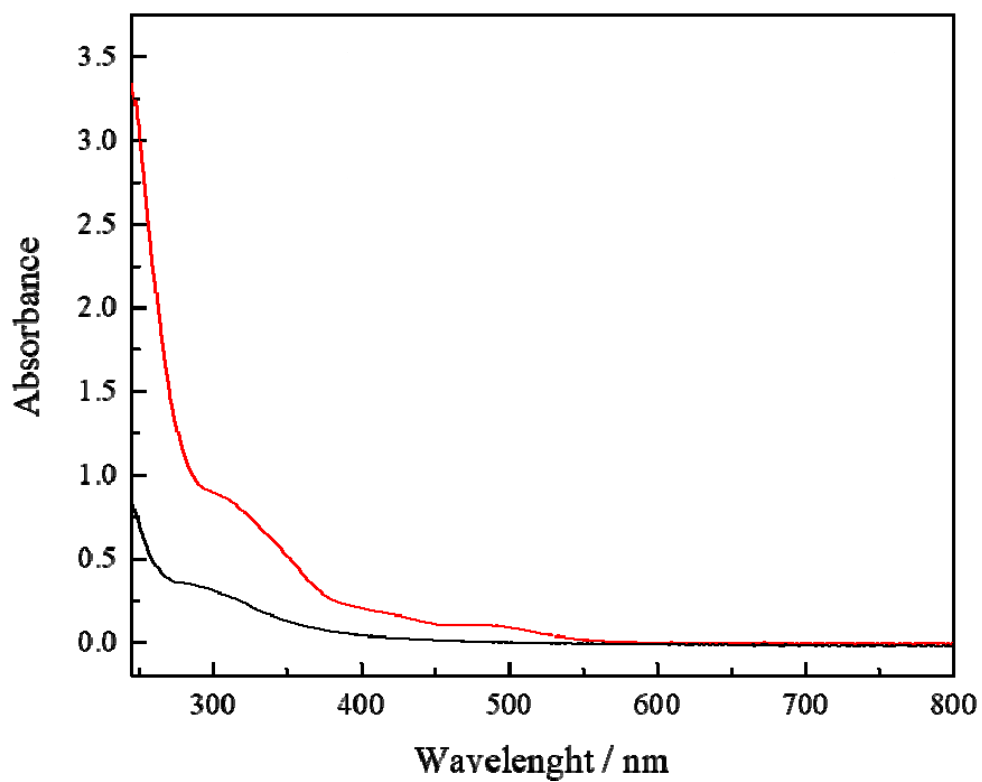


Figure S2. UV/Vis spectra of electrolyte recorded in the range from 250–800 nm at room temperature, where is red line related to the LiTFSI/C₂C₂imTFSI and the black line related to the LiTFSI/C₂C₂imTFSI/C₁C₄imSO₃ (spectra for electrolytes were recorded after galvanostatic cycling).

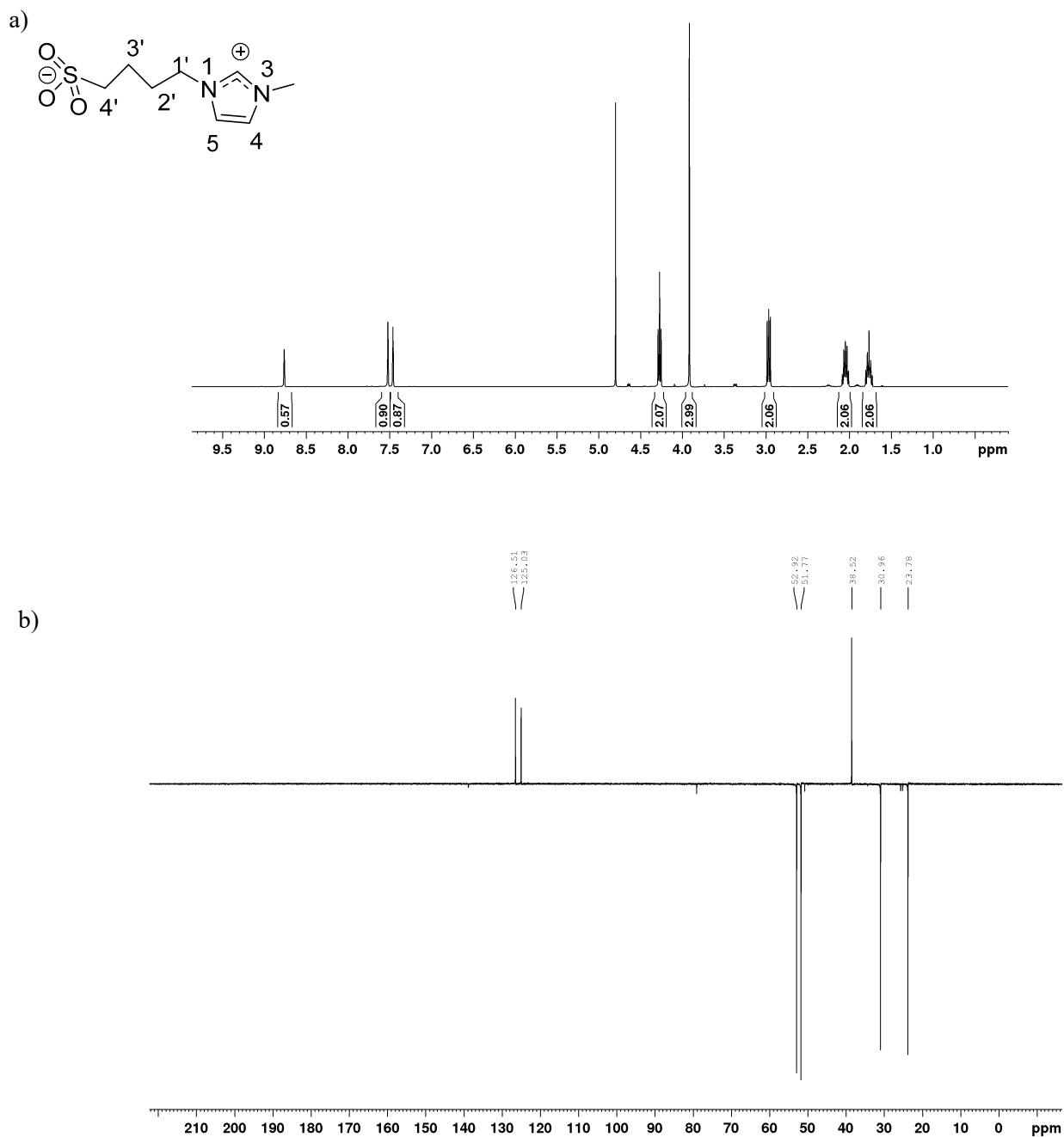


Figure S3. a) ^1H and b) ^{13}C NMR spectra for synthesized $\text{C}_1\text{C}_4\text{imSO}_3$

a) ^1H NMR: 1.76, m, 2H, $\text{NCH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{SO}_3^-$; 2.05, m, 2H, $\text{NCH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{SO}_3^-$; 2.96, m, 2H, $J=7.9$ Hz, $\text{NCH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{SO}_3^-$; 3.92, s, 3H, NCH_3 ; 4.27, t, 2H, $J=7.1$ Hz, $\text{NCH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{SO}_3^-$; 7.46, t, 1H, $J=1.9$ Hz, H-4; 7.52, t, 1H, $J=1.9$ Hz, H-5; 8.52, s, 0.6H, H-2.

b) ^{13}C NMR: 23.78 ($\text{NCH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{SO}_3^-$); 30.96 ($\text{NCH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{SO}_3^-$); 38.52 (NCH_3); 51.77 ($\text{NCH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{SO}_3^-$); 125.03 (C-5); 126.51 (C-4); 138.85 (C-2).

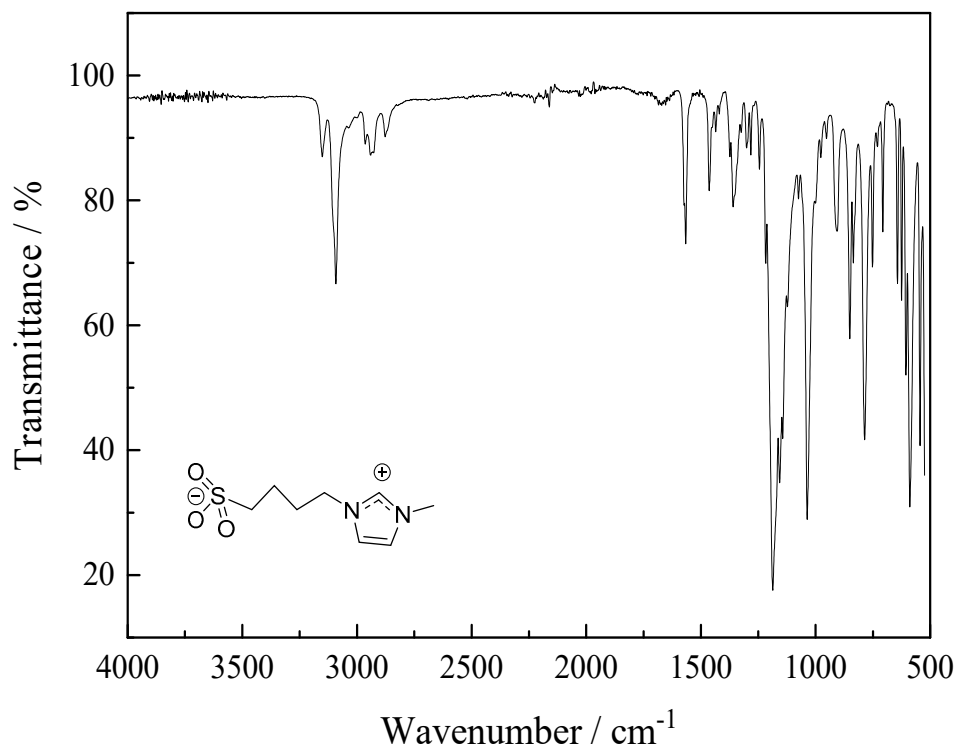


Figure S4. IR spectra of $C_1C_4imSO_3$

IR neat: 3158, 3114 (sym. stretching ν HC((4)C(5)H); 2959 (sym. stretching ν of imidazole ring ν CH₃ HCH); 2954, 2922 (asym. stretching ν C-H of -CH₃ and =CH₂); 2949 (asym. stretching ν CH₂); 1642 (stretching ν C=C); 1575 (in-plane ν of imidazolium ring); 1460 (C-N stretching of imidazole ring); 1450 (from methyl group, C-H bending); 1338 (SO₃ assymetric stretching); 1176 (skeletal ν of imidazolium ring); 1042 (out-of-plane C-H bending ν of imidazole ring); 974 (-S=O- stretching); 651 (C2-N-C5 bending ν of imidazole ring); 622, 607 (CCC in-plane ring bending).

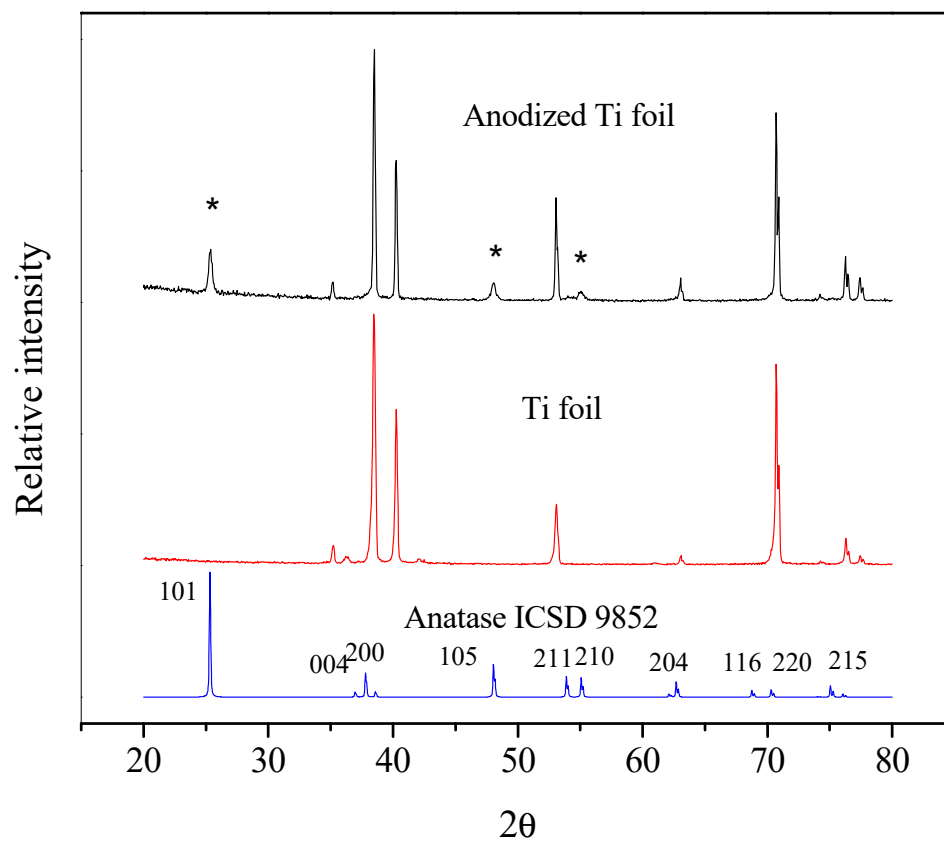
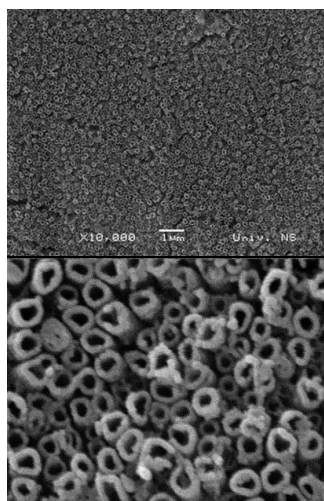


Figure S5. X-ray diffraction data for anodized Ti foil, Ti foil and anatase TiO_2 .



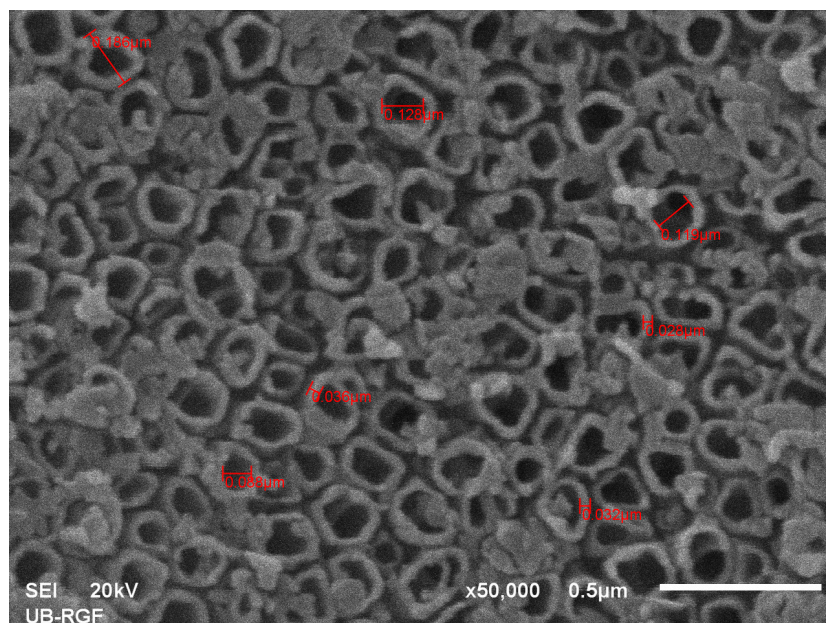


Figure S6. SEM images of TiO₂ nanotubes prepared by anodic oxidation (30 V, 6 hours) of Ti foil, with the thickness of the nanotube wall and the diameter of the nanotube opening.