

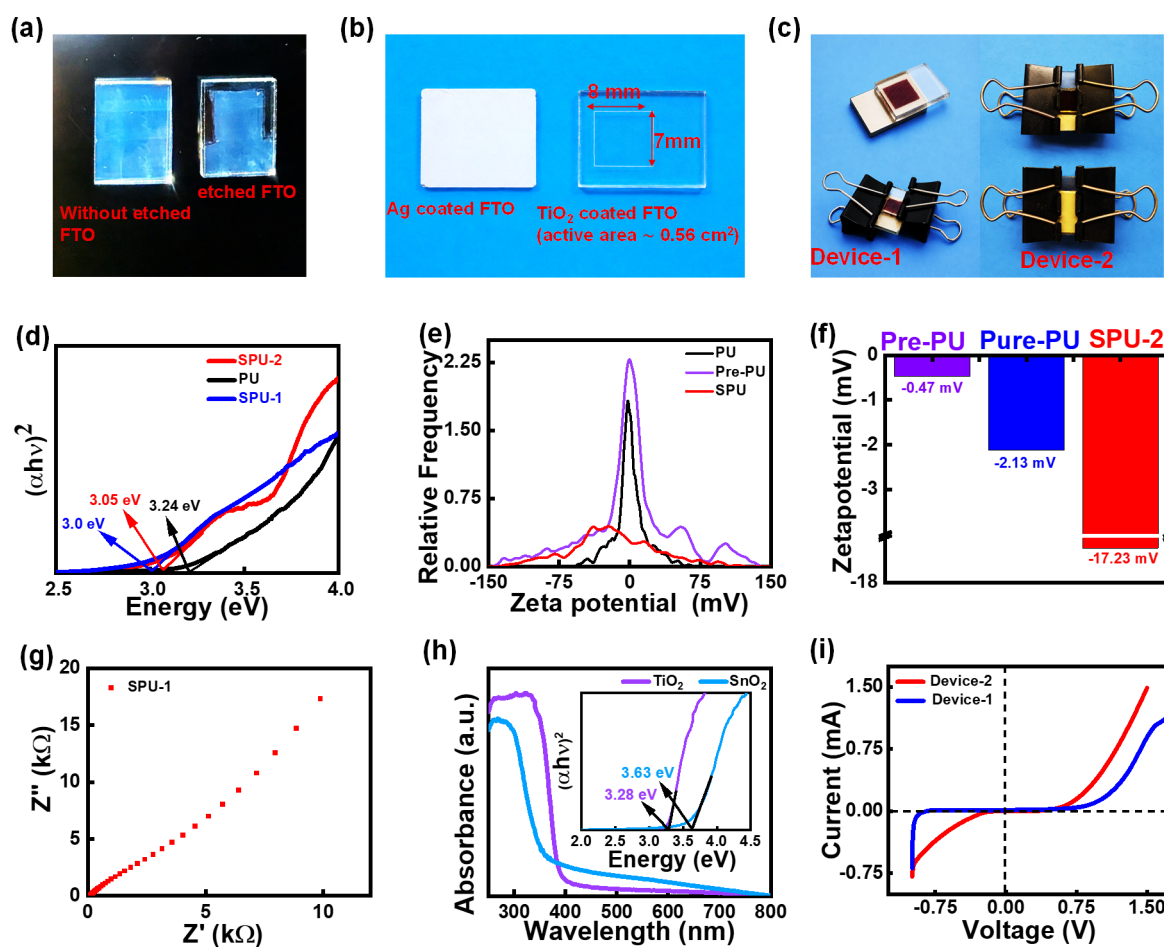


Figure S1. (a) show digital photographs of unetched and etched FTO-coated glass; (b) digital photograph of Ag and TiO₂ coated FTO. (c) digital photograph of Device-1 and Device-2; (d) zetapotential graph of Pre-PU, PU, and SPU-2; (e) graph of relative frequency and zetapotential of Pre-PU, PU and SPU-2; (f) histogram of the zetapotential of Pre-PU, PU and SPU-2; (g) Nyquist plots for SPU-1; (h) UV-vis absorbance spectra and Tauc plot curve (inset) of TiO₂ and SnO₂; (i) Dark *I-V* curve of Device-1 & Device-2.

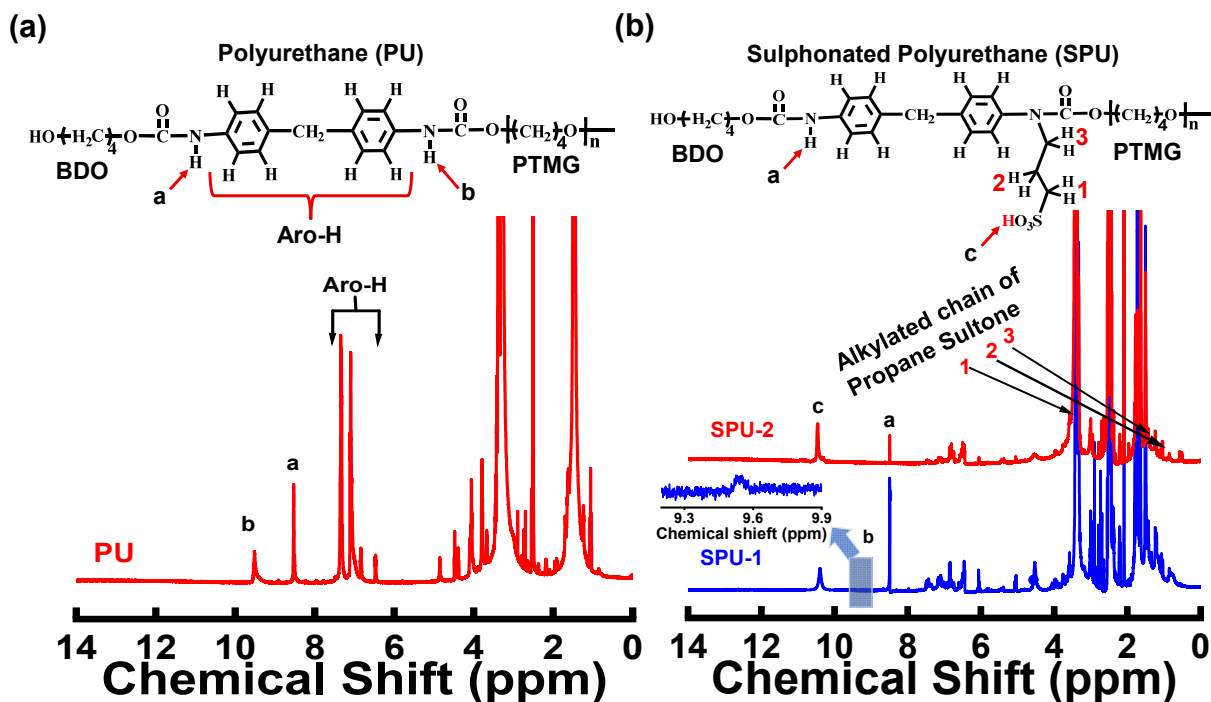


Figure S2: (a) ^1H NMR spectra of PU; (b) ^1H NMR spectra of SPU-1 and SPU-2.

The ^1H NMR spectra of pure PU are displayed in Figure S2a, where two types of N–H protons, denoted by the letters “a” and “b” are discovered. After sulfonation, the proton b (~ 9.5 ppm) is completely eliminated in SPU-2, whereas in SPU-1 it retains some amount, as shown in the inset of Figure S2b. However, in SPU-1, the “a” proton at about 8.5 ppm is not removed, whereas in SPU-2, some of it is removed. Therefore, SPU-2 has a greater degree of sulphonation ($\sim 64\%$) than SPU-1 ($\sim 28\%$). Following sulphonation, a new peak corresponding to the $-\text{SO}-\text{H}$ group appears at approximately 10.5 ppm, and the propane sultone alkyl chain proton is denoted by 1, 2, and 3, which are found at 3.96 ppm, 1.20 ppm, and 1.43 ppm, respectively, and shown in Figure S2b.