

Supplementary Information

Experimental Studies and Numerical Simulation of Polypyrrole Trilayer Actuator

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Supplementary Figures

1. Electrochemical cell setup
2. Fabrication steps
3. XRD of PPy curve fitting and LiTFSi doped PPy
4. Charge-discharge voltage and current of PPy actuator

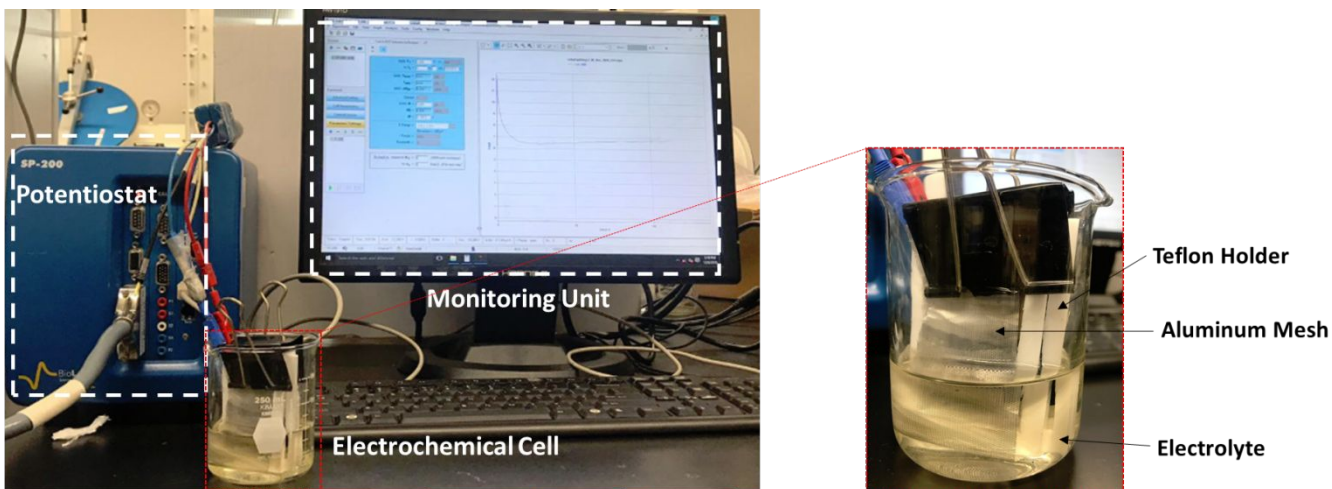


Figure S1 Electrochemical cell setup for polymerization Au/PVDF membrane

Electrochemical cell setup consists of Biologic potentiostat (SP-200), which is operating in the two-electrode configuration for polymerization. The working electrode (red clip) is connected to the Au/PVDF sheet whereas the counter electrode (blue clip) is connected to the Aluminum mesh. Teflon holder is used to avoid a short circuit between Au/PVDF and Al mesh as well as it also holds the thin membrane along with the mesh. Chronopotentiometry is used to provide constant current and the output voltage is monitored through Biologic potentiostat computer.

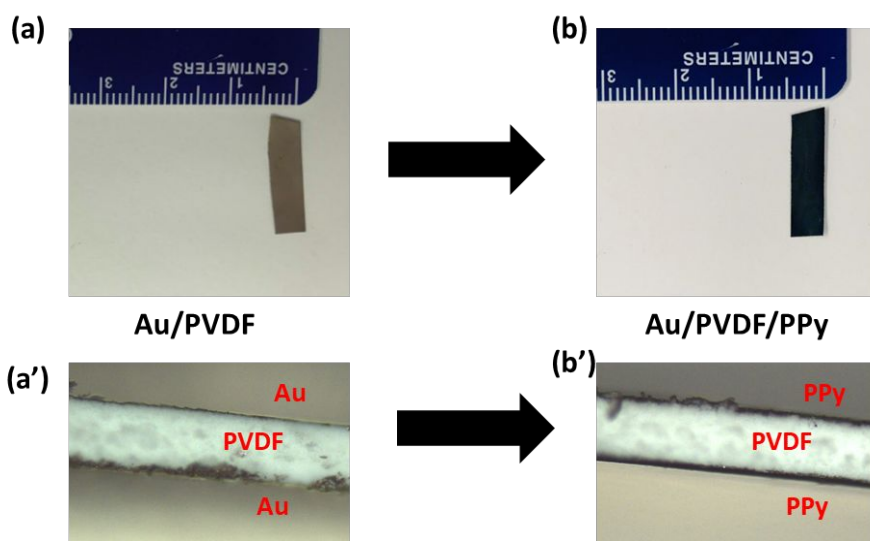


Figure S2 Fabrication steps (a) 1.5×0.5 cm Au sputtered PVDF (a') cross-section optical image of Au/PVDF (b) 1.5×0.5 cm PPy polymerized sheet (b') cross-section of the PPy polymerized sheet on Au/PVDF

In the fabrication steps, PVDF is sputtered with 7-8 nm of gold and measure the sheet resistance from four probe stations. After achieving 7 to 8 Ω -cm Au/PVDF sheet which is found to be decent conductivity to achieve highly crystalline and conductive PPy layer. A constant voltage is applied in two electrode configuration for 12h. at -16°C to attain 8 μm thick layer [1, 2].

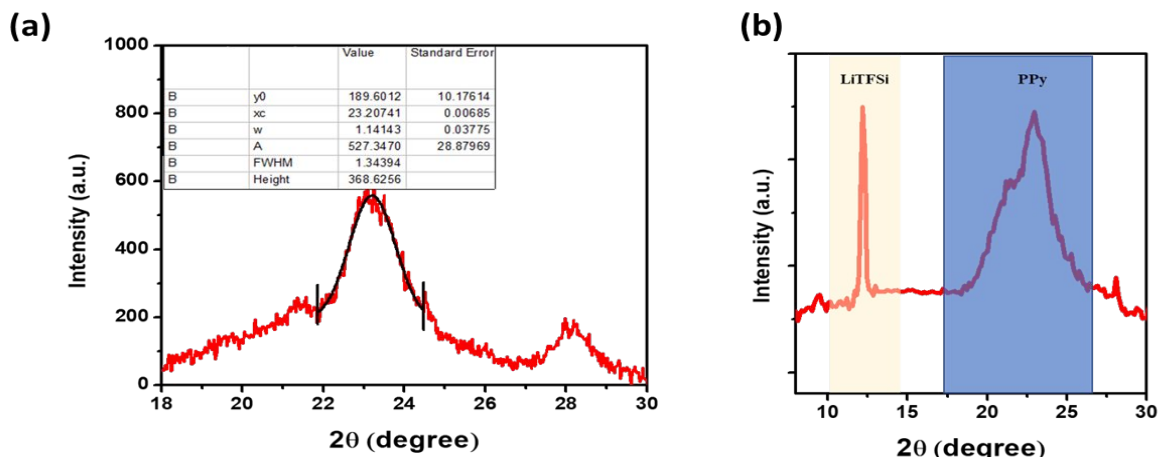


Figure S3 XRD peak (a) Curve fitting of PPy (b) LiTFSi with PPy

X-ray diffraction studies show that the PPy peak $2\theta = 23.1^{\circ}$ and FWHM is 1.34, which shows semi-crystalline in nature. The sharp peak is due to the scattering of interplanar spacing of PPy chains [3]. Long range of XRD data is taken to show the LiTFSi peak with PPy, which

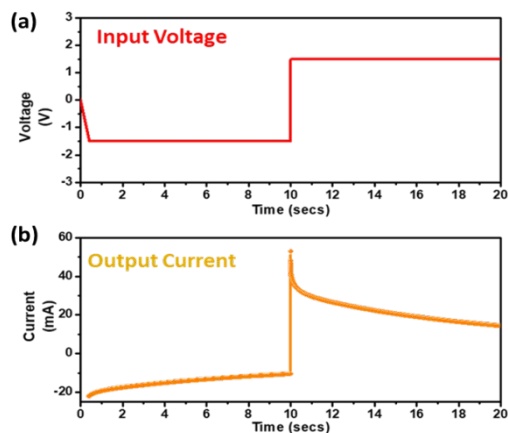


Figure S4. Oxidation and reduction of PPy actuator (a) Input Voltage (b) Output current

displays at $2\theta = 12.1^{\circ}$ [4].

Oxidation and reduction of bending of tri-layer actuator under a voltage of ± 1.5 V at 0.1 Hz square wave is applied to the gripped PPy/Au/PVDF membrane. The output current is

measured from Biologic potentiostat, which depends upon the insertion and extraction of the ions at polymer electrolyte interface [5].

Reference

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