

Supporting Information

Electroless Deposition of Gold

Polycarbonate membrane (PCM) of 600 nm pore diameter was immersed in a solution of 0.026 M SnCl_2 and 0.07 M trifluoroacetic acid (TFA) in 1:1 methanol-water, for 45 min. The membrane was then washed in three sets of 25 ml methanol by dipping for 10 min each. Washed membranes were immersed in 0.03 M ammoniacal AgNO_3 solution for 30 min and washed with water. Finally the membrane was kept in gold plating solution (pH 10) for 24 hours at 5 °C. Gold solution was prepared using 0.5 ml Oromerse B per 20 ml solution. The solution also contain 0.127 M Na_2SO_3 , 0.025 M NaHCO_3 and 0.625 M HCHO and the pH was maintained by 0.1 M H_2SO_4 . The gold coated membranes were then kept in 25% nitric acid for 12 hr for cleaning.

Electrodeposition of gold

Electrodeposition was done by cycling a commercially available electroplating gold solution (TSG-250 Sulfite Gold Plating Solution, Neutral pH, Transene Company, inc, Danvers MA01923) from 0 V to -0.5 V vs Ag/AgCl reference electrode, electroless deposited gold membrane as working electrode, Pt-foil as counter electrode. CHI 660B potentiostat was used for the electro deposition (Fig. S1)

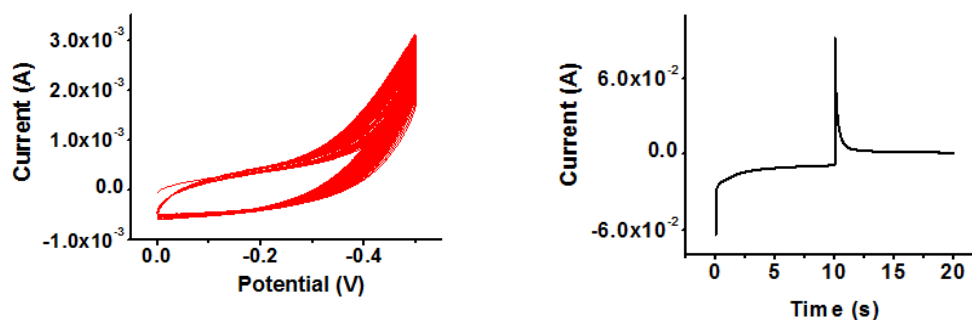


Fig. S1: Electrodeposition of gold (left) and electropolymerization of EDOT (right)

Electropolymerization of EDOT

Electropolymerization was done by taking electrodeposited gold membrane as working electrode and applying a constant potential of 1.3 V vs Ag/AgCl for 10 s in a 10 mM aqueous solution of EDOT and 100 mM lithium perchlorate as supporting electrolyte. Pt-foil was taken as counter electrode. Then -0.6 V vs Ag/AgCl was applied for 10 s (Fig S1).

Creating Charge on PEDOT

Constant potential of 0.4 V, 0.5 V, 0.6 V, 0.7 V and 1.0 V vs Ag/AgCl was applied to the PEDOT coated membranes in 100 mM aqueous lithium perchlorate solution for 2 min. Pt-foil was taken as counter electrode.

SDS (Sodium dodecyl sulphate) Treatment

Aqueous solution of 10 mM (above CMC) SDS was filtered through the positively charged PEDOT coated membranes *in vacuo*. 0.2 ml of solution was filtered four times and washed with copious amount of water. Before filtration the subject membranes were taped by a punched transparent tape.

Permeation Experiment

For all transport studies, two half U-tubes (one as feed and other as reservoir) were connected with the respective membranes held in between the two tubes. The amount of molecules transported from feed to reservoir was monitored by absorbance spectroscopy.

Determination of pore diameter

Pore diameter was calculated from phenol diffusion. 25 ml each of 5 mM phenol in water and blank water was taken as feed and reservoir respectively. A calibration curve i.e., amount of phenol transported per unit time (flux) against pore size (Fig S2) was generated by studying the phenol transport through five standard pore sizes of PCM 10 nm, 30 nm, 50 nm, 100 nm and 600 nm. Average pore diameter for all samples was calculated by fitting the flux into the calibration plot.

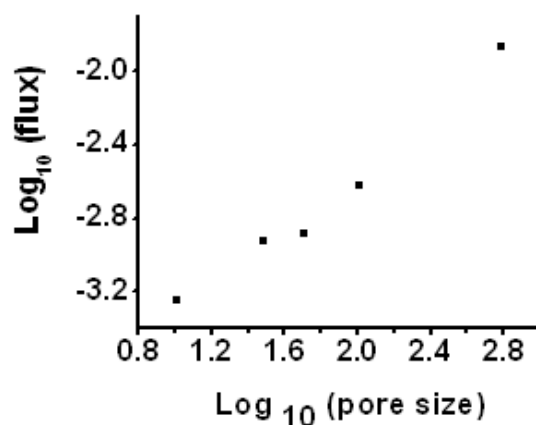


Fig. S2: Calibration plot

Dye Separation

Each pair of dye was 0.1 mM in phosphate buffer of pH 7.3 (PBS_{7.3}); 25 ml each of dye mixture and PBS_{7.3} was taken as feed and reservoir solutions, respectively.

A) Hydrophobicity based Separation (dyes used are p-nitrophenol and p-nitrotoluene):

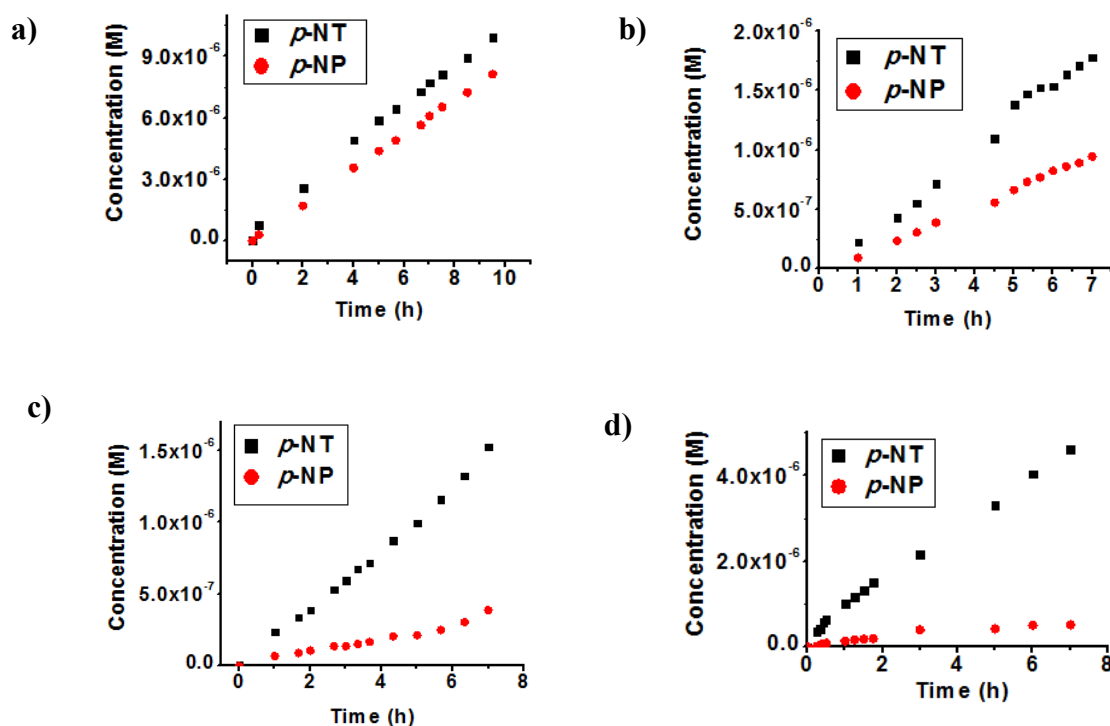


Fig. S3. Transport studies of p-NT and p-NP with positively charged PEDOT at applied potentials of a) 0.4 V, b) 0.5 V, c) 0.6 V and d) 0.7 V. After oxidation, SDS was filtered through the pores to modify the tubes.

Table S1: Separation factor and pore diameter with potential variation for hydrophobicity based separation

Potential Applied (V)	Pore Diameter (nm)	Separation Factor (α)	Diffusion Rate (M/h)		Diffusion Rate / Area* (M/h cm ²)	
			p-NT	p-NP	p-NT	p-NP
0.0	8	0.9	2.05×10^{-7}	2.24×10^{-7}	12.97×10^{-7}	14.18×10^{-7}
0.4	15	1.2	1.08×10^{-6}	8.61×10^{-7}	6.83×10^{-6}	54.49×10^{-7}
0.5	13	1.9	2.74×10^{-7}	1.43×10^{-7}	17.15×10^{-7}	9.05×10^{-7}
0.5	11	2.5	3.07×10^{-7}	1.20×10^{-7}	19.43×10^{-7}	7.59×10^{-7}
0.6	10	4.3	2.06×10^{-7}	4.86×10^{-8}	13.04×10^{-7}	30.76×10^{-8}
0.7	8	7.9	6.86×10^{-7}	8.70×10^{-8}	43.41×10^{-7}	55.06×10^{-8}
1.0	7	8.9	8.63×10^{-7}	9.67×10^{-8}	54.62×10^{-7}	61.20×10^{-8}

*Area (punch hole) = 0.16 cm²

SDS Concentration below CMC

SDS solution of concentration below CMC (2mM) was filtered and studied for dye separation. Separation is as show in Fig S4.

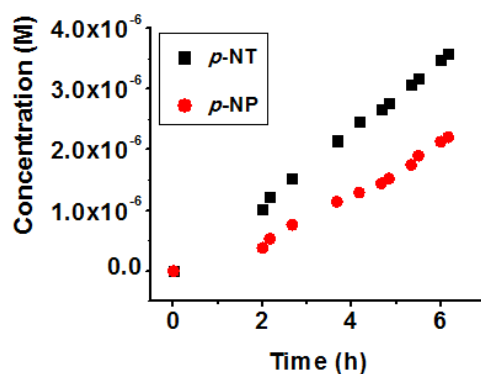


Fig S4. Transport study of *p*-NT and *p*-NP with PEDOT charged at 1V and 2mM (below CMC) SDS filtered

B) Charge based Separation (dyes used Rhodamine 6G and Calcein):

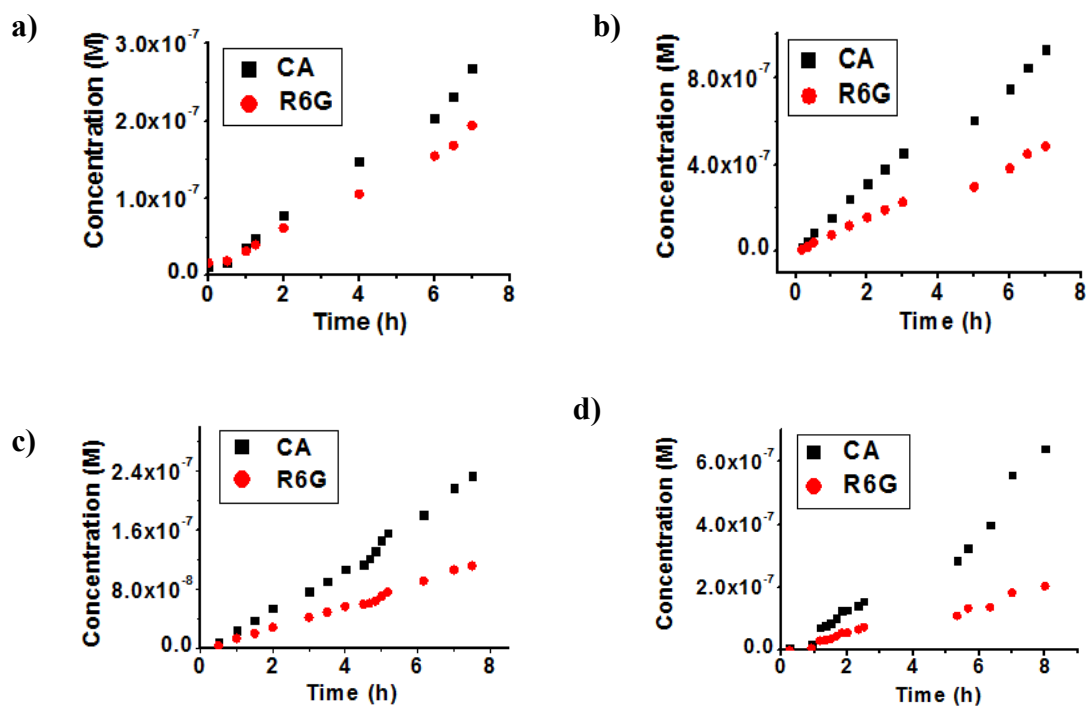


Fig. S5. Transport studies of R6G and CA with a) neutral PEDOT and positively charged PEDOT at applied potentials of b) 0.4 V, c) 0.7 V (6 nm pore size) and d) 0.7 V (4 nm pore size).

Table S2: Separation factor (α) and pore diameter with potential variation for charged based separation

Applied Potential (V)	Pore Diameter (nm)	Separation Factor (α)	Diffusion Rate(M/h)		Diffusion Rate / Area* (M/h cm ²)	
			R6G	CA	R6G	CA
0.0	7	1.3	3.65×10^{-8}	2.67×10^{-8}	23.10×10^{-8}	16.89×10^{-8}
0.4	6	1.9	1.24×10^{-7}	6.53×10^{-8}	7.85×10^{-7}	41.33×10^{-8}
	6	2.1	3.16×10^{-8}	1.51×10^{-8}	20.00×10^{-8}	9.55×10^{-8}
0.7	4	2.8	6.87×10^{-8}	2.43×10^{-8}	43.48×10^{-8}	15.38×10^{-8}
	4	2.9	6.83×10^{-8}	2.83×10^{-8}	43.23×10^{-8}	15.06×10^{-8}

*Area (punch hole) = 0.16 cm²

SEM Images

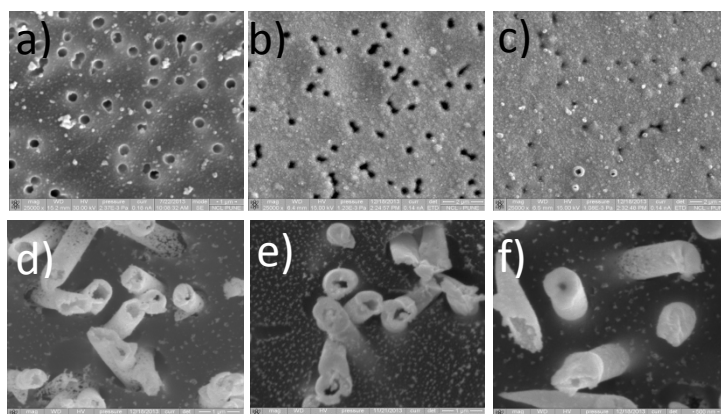


Fig. S6: SEM images: Surface morphology after 24 hr electroless deposition of gold (a), electrodeposition of gold for 60 cycles (b) and 120 cycles (c). Polycarbonate template partially etched by oxygen plasma(d-f)

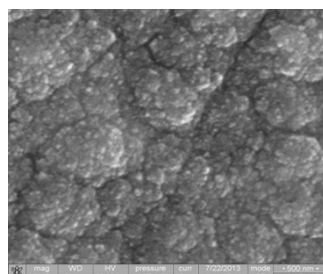


Fig. S7: SEM image of 600 nm PCM after electroless gold deposition followed by electrodeposition of gold and PEDOT electropolymerized.

Contact Angle

30 nm PCM were used for measuring water drop contact angle. Electroless gold deposition was done followed by electrodeposition of gold and electropolymerization of EDOT. Contact angle was measured both with and without SDS treatment.

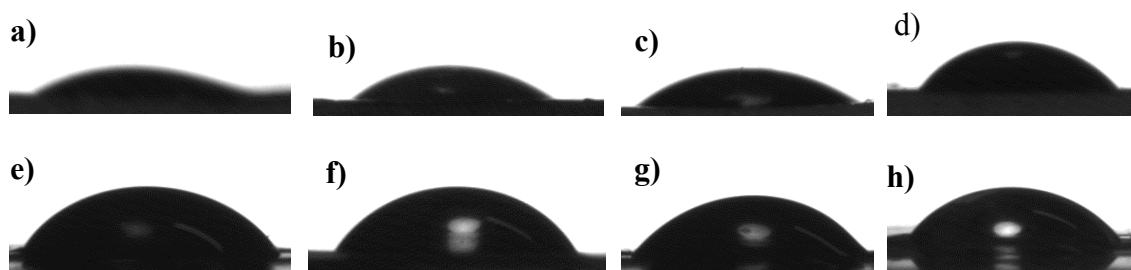


Fig. S8: Contact angle for without SDS treatment a) electroless gold on 30 nm PCM, b) followed by electrodeposition of gold (60 cycles), c) electropolymerized EDOT neutral, d-h) applied potential of 0.4 V, 0.5 V, 0.6 V, 0.7 V and 1.0 V respectively.

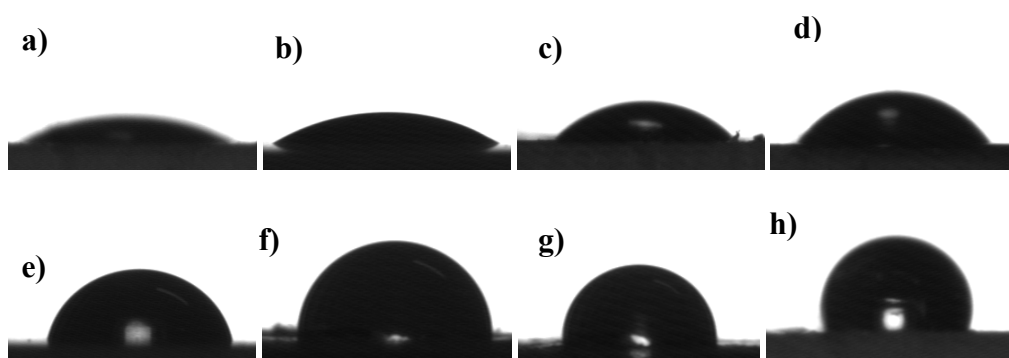
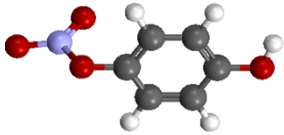
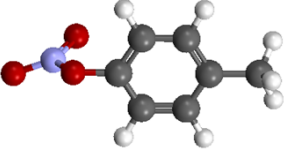


Fig. S9: Contact angle for after SDS treatment a) electroless gold on 30 nm PCM, b) followed by electrodeposition of gold (60 cycles), c) electropolymerized EDOT neutral, d-h) applied potential of 0.4 V, 0.5 V, 0.6 V, 0.7 V and 1.0 V respectively.

Table S3: Contact angle with and without SDS treatment

SAMPLE	CA (without SDS treatment)	CA (after SDS treatment)
30nm_24h	25°	24°
30nm_24h_60	32°	34°
1.3V	35°	38°
1.3V_0.4V	40°	59°
1.3V_0.5V	42°	76°
1.3V_0.6V	56°	95°
1.3V_0.7V	57°	102°
1.3V_1.0 V	57°	110°

Table S4: Simulations of molecules used for permeation experiment

Dye	3D-Structure	Solvent Excluded Volume (Å ³)	Total Polar Surface Area(Å ²)
p-Nitrophenol		109.64	69.77
p-Nitrotoluene		120.15	49.54