Experimental

All chemicals were purchased from Aldrich Chemical and used as received unless otherwise noted. Dichloromethane and acetonitrile were freshly distilled over CaH₂ under N₂ atmosphere. Tetrabutylammonium hexafluorophosphate (TBAH) was used as an electrolyte. Redox behaviour and polymerization were performed in an electrolyte solution of 0.1 M TBAH dissolved in dichloromethane. Also, electrochemical and optical properties of the polymer were studied in dichloromethane containing 0.1 M TBAH. In three-electrode system, platinum disc (0.03 cm²) and platinum wire electrodes were used as working and counter electrodes, respectively. A Ag/AgCl electrode in 3 M NaCl(aq) solution was used as a reference electrode calibrated externally using 0.53 mM solution of ferrocene/ferrocenium couple in 0.1 M TBAH/CH₂Cl₂ solution. The oxidation maximum and onset potential of ferrocene was found as 0.54 V and 0.42 V vs Ag/AgCl, respectively. Electrochemically obtained polymer films were synthesized both by repetitive cycling and constant potential electrolysis. After electropolymerization, polymer coated working electrode was washed with CH₂Cl₂ to remove the unreacted monomers and oligomeric species. Then, in order to get repeatable results in electrochemical and optical studies the polymer film was switched several times between its redox states. Optical properties were investigated in situ by using an indium-tin oxide (ITO, Delta. Tech. 8–12 Ω, 0.7 x 5.0 cm²) electrode as a working electrode in a UV cuvette. A platinum wire and Ag wire electrodes were used as a counter and a pseudo-reference electrodes, respectively.
Electroanalytical measurements were performed using a Gamry PCI4/300 and Gamry Reference 600 potentiostat–galvanostat. The electro-optical spectra were monitored on a Specord S600 spectrometer. The optoelectrochemical spectra of the film were recorded in-situ under applied different potentials. Also, a square wave potential method was used to investigate the ability of switching of the polymer film between its neutral and doped states. 

$^1$H and $^{13}$C NMR spectra were recorded on a Bruker Spectrospin Avance DPX-400 Spectrometer and chemical shifts were given relative to tetramethysilane as the internal standard. The Spectrum of High Resolution Mass Spectrometry was recorded on a Water, Synapt HRMS. Photographs of the polymer film were taken using a Canon (PowerShot A75) digital camera. Colorimetric measurements were recorded on Specord S600 (standard illuminator D65, field of width $10^\circ$ observer) and color space was given by the International Commission of Illumination with luminance (L), hue (a), and intensity (b). Platinum cobalt DIN ISO 621, iodine DIN EN 1557, and Gardner DIN ISO 6430 are the references of colorimetric measurements.

Compounds 3,4-dimethoxyselenophene and 2,2-bis((naphthalen-2-yl)methyl)propane-1,3-diol were prepared according to literature procedures.
Figure S1. $^1$H NMR spectrum of ProDOS-Np$_2$ in CDCl$_3$.

Figure S2. $^{13}$C NMR spectrum of ProDOS-Np$_2$ in CDCl$_3$. 
**Figure S3.** FTIR spectrum of ProDOS-Np₂.

**Figure S4.** Elemental Composition Report of PrpDOS-Np₂.
Figure S5. (a) Scan rate dependence of PProDOS-Np$_2$ film on a Pt disk electrode in 0.1 M TBAH/CH$_2$Cl$_2$ at different scan rates between 40 mV/s and 200 mV/s with 20 mV/s increments: (mV/s) (a) 40; (b) 60; (c) 80; (d) 100; (e) 120; (f) 140; (g) 160; (h) 180; and (i) 200, (b) the amount of charge ($Q_a$) and discharge ($Q_c$) as a function of scan rate for neutralized and oxidized film and (c) relationship of anodic ($i_{ac}$) and cathodic ($i_{cc}$) current peaks in 0.1 M TBAH/CH$_2$Cl$_2$ solution.

Figure S6. (a) Cyclic voltammogram of PProDOS-Np$_2$ film on Pt electrode in 0.1 M TBAH/CH$_2$Cl$_2$ solution between -0.3 V and 1.2 V and then between 0.45 V and 1.2 V at a scan rate of 100 mV/s (b) Cyclic capacitance effect of PProDOS-Np$_2$ film on the Pt disk electrode in 0.1 M TBAH/CH$_2$Cl$_2$ at different scan rates between 40 mV/s and 200 mV/s with 20 mV/s increments: (mV/s) (a) 20; (b) 40; (c) 60; (d) 80; (e) 100; (f) 120; (g) 140; (h) 160; (i) 180 and (j) 200, and (c) the amount of charge ($Q_a$) and discharge ($Q_c$) as a function of scan rate for neutralized and oxidized film in 0.1 M TBAH/CH$_2$Cl$_2$ solution.
Figure S7. Chronoabsorptometry experiments for (a) PProDOS-Np$_2$ and (b) PProDOT-Np$_2$ films on ITO in 0.1 M TBAH/CH$_3$CN while the polymers were switched in 10 s time intervals between redox states.