LIST OF FIGURES

Figure Captions	Page
	No.
Fig.1.1 Comparative properties of organic vs. conventional electronics.	3
Fig. 1.2 Size of excitons for an inorganic semiconductor and an organic	3
semiconductor	
Fig. 1.3 Chemical structures of common carbocyclic and heterocyclic organic	6
conducting polymers. Here 'n' written outside the parenthesis represents union of the	
respective monomers	
Fig. 1.4 (a) In ethylene, the sigma-pi bonding of carbon atoms, (b) In benzene ring, the	7
delocalized π -electron-system	
Fig. 1.5 (a) The lowest electronic excitation (optical excitation) in the case of energy	10
levels of a π -conjugated molecule, (b) Formation of bands with the separation of	
energy gap (by the collection of molecular orbitals)	
Fig.1.6 The process of doping (n-type) in case of poly (acetylene)	13
Fig. 1.7 The process of doping (p-type) in case of poly (thiophene)	13
Fig.1.8 Formation of polarons and bipolaron in Polypyrrole	15
Fig.1.9 Formation of solitons in conducting polymers	16
Fig. 1.10 Various methods of doping process.	18
Fig. 1.11 Doping Mechanism in polyaniline by acid-base chemistry	20
Fig. 1.12 some example of side chains (a) Linear alkyl chains (b) Cyclic alkyl chains	23
(c) Branched alkyl chains.	
Fig. 1.13 Structural formula of (3- hexylthiophene) (a), regioirregular poly(3 hexyl	24

thiophene) (b) (b'), and regioregular poly(3 hexylthiophene) (c), respectively.	
Fig. 1.14 Edge on (a) face on (b) and, Flat-on (c) orientation of regioregular PATs	25
Fig. 1.15 Charge transport in OFET fabricated using (a) edge- on oriented and (b) face	27
-on oriented polymer chains.	
Fig. 1.16 Charge transport in PAT sandwiched diode fabricated using (a) edge- on	27
oriented, (b) face -on oriented and (c) end-on oriented polymer chains.	
Fig.1.17 Various methods of orientation of PATs.	29
Fig. 1.18 Structural formula of (a) poly(3- hexylthiophene) (b) Poly (3,3"'-	31
didodecylquarterthiophene) (c)Poly(2,5-bis(3-alkylthiophen-2-yl)thieno[3,2-	
b]thiophene).	
Fig.1.19 Some examples of electronic devices based upon polymer /metal interface	32
Fig.1.20 Energy level diagram of metal and semiconductor (a) before the contact (b)	37
after the contact	
Fig.1.21 Energy level diagram of metal/semiconductor (n-type) interface under (a)	37
thermal equilibrium (b) forward biasing and (c) reverse biasing	
Fig. 1.22 Energy level diagram of metal and semiconductor (a) before the contact (b)	39
after the contact	
Fig. 1.23 Energy level diagram of metal/semiconductor (p-type) interface under (a)	40
thermal equilibrium (b) forward biasing and (c) reverse biasing	
Fig.1.24 Formation of energy level diagram in metal and semiconductor (a) before the	41
contact (b) after the contact	
Fig1.25 Current flow mechanism in Schottky Diode	43
Fig. 2.1 Block diagram of single beam spectrophotometer.	58
Fig. 2.2 Block diagram of double beam spectrophotometer.	59
Fig. 2.3 Block diagram of photoluminescence spectroscopy	61

Fig. 2.4 Schematic of working principle of atomic force microscopy used for surface analysis.	62
Fig. 2.5 Physical process involved in XPS and photoelectron emission	63
Fig. 2.6 Block diagram of modern electron spectroscopy for chemical analysis.	64
Fig. 2.7 Schematic diagram of scanning electron microscope.	65
Fig. 2.8 Schematic diagram of transmission electron microscope.	67
Fig. 2.9 Block diagram of FT-IR spectroscopy.	68
Fig. 2.10 Schematic diagram of Raman spectrometer.	69
Fig. 2.11 Block diagram of three electrode connections.	70
Fig. 2.12 Schematic representations of devices.	71
Fig. 2.13 Schematic diagram of vacuum thermal evaporations unit.	73
Fig. 2.14 Block diagram of I-V measurement system (a) in case of diode (Schottky)	74
application (b) in case of photodetector application.	
Fig. 3.1 (a) Photograph of Isolated (left) and aggregated pBTTT-C14 in 100T and (b)	71
schematic representation of pBTTT-C14 assembly.	
Fig.3.2 UV visible spectroscopy of pBTTT-C14 in 0T (I), full T (II) after successive	81
time interval of 60s, UV visible spectroscopy of pBTTT-C14 in 0T (a), 50T (b), 100T	
(c), 150T (d), 200T (e) & full T (f)(III), absorbance kinetics of pBTTT-C14 in 0T (a),	
50T (b), 100T (c), 150T (d), 200T (e) & full T (f) at wavelength= 470nm (IV) & 590	
nm (V) and UV visible of pBTTT-C14 in 100T after successive time interval of 60 s	
(a-f) (VI).	
Fig. 3.3 (I) Absorption kinetics for 9 h at 590 nm and (II) photoluminescence spectra	82
(PL) of (a) isolated & (b) aggregated pBTTT-C14 in100T.	
Fig. 3.4 Gaussian fitting UV visible plots of pBTTT-C14 dispersed in 0T (a), 50T (b),	84
100T (c), 150T (d), 200T, full T (f) and plot of A' (= A_{0-0}/A_{0-1}) vs. amount of toluene	

addition (g).	
Fig. 3.5 XRD of (a) isolated & (b) aggregated pBTTT-C14 thin film in100T.	85
Fig. 3.6 AFM images of isolated (a-f) and aggregated (a'-f') pBTTT-C14 films	87
prepared in 0T, 50T, 100T, 150T, 200T & full T. Inset of Fig. 3.6 (f') shows AFM of	
pBTTT-C14 film prepared in full T on large area.	
Fig. 3.7 Large area AFM and corresponding phase image (a & b), magnified AFM	88
image with height profile (c), large area TEM image (d), HRTEM image (e) and	
SAED pattern of pBTTT-C14 fiber prepared in 100T.	
Fig. 3.8 AFM in topographic (a), phase (b) and KPFM (c) of fibrous pBTTT-C14	89
prepared in 100T.	
Fig.3.9 <i>J-V</i> and <i>logJ-V</i> characteristics of isolated (a & a') and aggregated (b & b')	94
pBTTT-C14 prepared in 100T based devices respectively. Inset represents device	
schematic.	
Fig.3.10 Double logarithmic (J-V) plot of aggregated (I) and isolated (II) pBTTT-C14	95
prepared in 100T based devices respectively.	
Fig. 3.11 Film thickness measurement by AFM for (a) isolated and (b) aggregated	95
pBTTT-C14 prepared in 100T.	
Fig. 4.1 Schematic representation for H-and J-aggregation in rr-PQT-12 (PQT-12	100
chain is shown at bottom).	
Fig. 4.2 (I) UV-visible analysis of isolated (a, b and c) and aggregated (a', b' and c')	
rr-PQT-12 for 0.026%, 0.055% and 0.125% w/v respectively, (II) Time dependent	102
absorbance analysis of (a) 0.026% w/v, (b) 0.055% w/v and (c) 0.125% w/v in	
chloroform and (III) PL of (a) aggregated and (b) isolated rr-PQT-12 excited at 473	
nm. Inset of Fig. 4.2(I) represents photograph of change in colour of rr-PQT-12	
solutions from zero time (isolated) marked as (i) and after 45 minutes aging	

(aggregated) marked as (ii).	
Fig. 4.3 XRD of (a) aggregated and (b) isolated rr-PQT-12.	103
Fig. 4.4 AFM image and their corresponding height of 0.026% w/v rr-PQT-12 (a &	104
a'), 0.055% w/v rr-PQT-12 (b & b') and 0.125% w/v rr-PQT-12 (c & c').	
Fig. 4.5 HRTEM image of fibrous PQT-12. Inset shows zoomed view of same	105
micrograph.	
Fig. 4.6 (I) J-V Characteristics and (II) log-log J-V plot of (a) isolated and (b)	108
aggregated rr-PQT-12. Inset shows the device schematic diagram.	
Fig. 5.1 (I) Chemical interactions of DNA, DDAB and rr-PQT-12 in DNA-DDAB/rr-	116
PQT-12 fiber and (II) possible assembly of rr-PQT-12 over DNA-DDAB complex.	
Fig. 5.2 UV visible spectra of (a) D2, (b) S2/rr-PQT-12 and (c) D2/rr-PQT-12 in	117
chloroform. Inset shows white precipitate of D2.	
Fig. 5.3 PL spectra of (a) rr-PQT-12, (b) S2/rr-PQT-12 and (c) D2/rr-PQT-12	118
solutions. ($\lambda_{ex} = 475 \text{ nm}$).	
Fig. 5.4 Time resolved florescence decay curves of (I) rr-PQT-12, (II) S2/rr-PQT-12	120
and (III) D2/rr-PQT-12 solutions. ($\lambda em = 369 \text{ nm}$).	
Fig. 5.5 TEM image (a & b), SAED pattern (c & d) and AFM image (e & f) of S2/rr-	122
PQT-12 and D2/rr-PQT-12.	
Fig. 5.6 KPFM and AFM (in topographic and their phase image) of D2/rr-PQT-12 (a,	123
a'& a''), S2/rr-PQT-12 (b, b' & b'') and rr-PQT-12 (c, c'& c'') respectively.	
Fig. 5.7 J-V characteristics of (I) rr-PQT-12 (II) ND/rr-PQT-12 and (III) S2/rr-PQT-	128
12, S4/rr-PQT-12, S8/rr-PQT-12, D2/rr PQT-12, D4/rr-PQT-12 and D8/rr-PQT-12 (a-	
f) and log J-V plot of (IV) S2/rr-PQT-12, S4/rr-PQT-12, S8/rr-PQT-12, D2/rr-PQT-	
12, D4/rr-PQT-12 and D8/rr-PQT-12 (a-f). Inset pictures of Fig. 5.7 (I & III),	
represents the fabricated device schematic and variation of current density (J) with	

DNA contents in respective composites respectively.	
Fig. 5.8 log J-log V plot of (a) ITO/rr-PQT-12/Al, (b) ITO/S2/rr-PQT-12/Al and (c)	130
ITO/D2/rr- PQT-12/Al devices.	
Fig. 5.9 Time dependent device performance of (I) S2/rr-PQT-12 (II) D2/rr-PQT-12	130
and (III) combined RR vs. number of days plot for (a) S2/rr-PQT-12 & (b) D2/rr-PQT-	
12 based devices.	
Fig. 6.1 UV-vis spectra depicting SPR of hydrosol, silver nanoparticles in chloroform	138
(after phase transfer) and, silver nanoparticles retained in aqueous phase (after phase	
transfer)	
Fig. 6.2 TEM images of (a) Hydrosol, (b) Organasol (after phase transfer), (c) HR-	139
TEM image of organosol (after phase transfer), & (d) SAED image of organosol	
Fig. 6.3 (a) Schematic representation of Ag NPs dispersion into rr-PQT-12, (b)	
representation of the precise growth of Ag@PQT-12 (AgNPs@rr-PQT-12) thin film	
on the surface of high surface tension mobile liquid substrate accomplished by surface	140
tension gradient and compressive force (c) surficial flow of hybrid solution on the	
liquid substrate (d) Illustrations of formation of Ag NPs decorated rr-PQT-12 in S>0	
and S<0.	
Fig. 6.4 TEM images (a & b), size distribution (c) & (d) SAED image of	142
AgNP@PQT.	
Fig. 6.5 AFM (a) height, SPC and phase contrast image of (a-c) pristine PQT-12 and	143
(d-e) AgNPs@PQT-12 based polymer films.	
Fig. 6.6 GIXD of PQT@Ag NPs and pristine PQT film formed over high surface	144
energy liquid substrate.	
Fig. 6.7 Raman spectra of pristine PQT and Ag@PQT film, respectively	147
Fig. 6.8 J –V characteristics of PQT@Ag under illumination of different wavelength.	149

Inset picture shows the device schematics.	
Fig. 6.9 X-ray photoelectron spectroscopy of pristine PQT and Ag@PQT, respectively	149
Fig. 7.1 SEM images of (a) synthesized SnO_2 nanowire, (b) rGO and (c) SnO_2/rGO	157
film on SiO ₂ /Si substrate, Inset shows the zoom image of encircled region at 20KX	
magnification.	
Fig. 7.2 XRD of SnO ₂ nano-wires. Observed (red dots), calculated (black line), and	158
difference (green line), respectively.	
Fig. 7.3 XRD of (a) SnO ₂ nanowire, (b) rGO and (c) SnO ₂ /rGO hybrid material.	160
Fig. 7.4 UV-Vis Transmittance spectra of (a) SnO ₂ , rGO and SnO ₂ /rGo hybrid	161
material in ethanol (Inset shows band gap energy plot for SnO ₂) and (b) transmittance	
spectra of the glass as well as SnO ₂ /rGO deposited thin film on glass substrate.	
Fig. 7.5 The FTIR spectra of GO, rGO and SnO ₂ /rGO hybrid materials.	162
Fig. 7.6 AFM topography of SnO ₂ /r-GO hybrid film deposited over SiO ₂ .	164
Fig. 7.7 CV of bare glassy electrode, SnO ₂ and SnO ₂ /r-GO respectively	165
Fig. 7.8 (a) I-V characteristics of the thin film (ITO on Glass substrate) taken by Pt	166
coated conducting Si tip in AFM mode, schematically represented in (b).	
Fig. 7.9 (a) I-V characteristics SnO_2/rGO hybrid material in Au-SiO ₂ / rGO-Au	168
structure along the film under FET configuration without gate voltage under dark	
condition and illumination of red and blue light, respectively. (b) Schematics of	
generation of photo current after illumination.	