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COMPARATIVE STUDY OF THE ELECTROCHEMICAL PREPARATION OF THE OPD COATED PANI AND PPD COATED PANI ON THE BASIS OF THE ROTATION SPEED VARIATION OF RDE (ROTATING DISC ELECTRODE).

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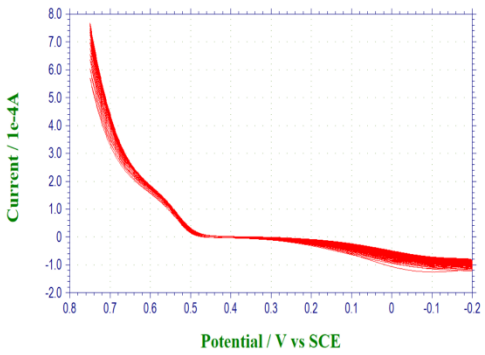
Abstract: The OPD(Ortho phenylene diammine) and PPD(Para phenylenediammine) are polymerized on the PANI film which is already coated on the platinum RDE(Rotating Disc electrode) by cyclic voltammetrically.During the preparation of the pOPD(poly Ortho Phenylenediammine) and pPPD (poly Para Phenylenediammine) the rotation speed of the RDE(Rotating Disc electrode) is varied from 100 RPM to 3000 RPM.The Charge stored in the polymer film and peak current is noted every time of the polymer CV curve and from that data various conclusions are drawn as per the Levich equation.
It is found that the charge stored in the polymer film and peak current both are increases when the RDE speed is increased, further the same is observed when the concentration of monomer is increases from 1.25 mM to 20 mM.

Keywords: Poly para phenylenediammine, Poly ortho phenylenediammine, Peak current, Rotation speed, Levich equation, Charge, Atomic Force Microscopy, Wettability, Contact angle etc.

Introduction: The cyclic voltammetry is used to prepare and characterize different polymers/ICPs which are useful in many fields like batteries, catalysis, electrochromic devices etc. The OPD and PPD can also be polymerized by electrochemically but very less earlier attempts are found regarding this specifically about PPD and OPD polymerization.The mixture of these monomers are polymerized by many researchers but here we use the PANI as catalyst/influencer to polymerize the PPD and OPD.Here we try to study the effect of rotation speed on polymerization of PPD as pPPD and OPD as pOPD.One more thing that we vary the concentration of these monomers from 1.25 mM to 20 mM and for each of these concentrations the polymerization is done by varying the rotation speed of the RDE in RPM from 100 to 3000 RPM.As the speed of the RDE is changes from low to high then how the peak current value and charge stored capacity of these polymers changes at that particular concentration is accounted. The results are explained in terms of the Levich equation which is for the rotation rate effect on electrochemical polymerization.
We come to point that the polymerization of PPD and OPD is enhanced by polyaniline and the polymerization is happened easily.The increase in the rotation speed directly affects the peak current of CV curve and that is as the rotation speed of the RDE increased ,the peak current is also increases.The Charge stored in the polymeric film is also increases with the speed. Another thing as the concentration of the monomer increases then the peak current is increases as well as the charge is also increases.

Experimental: The P-Phenylenediammine and O-Phenylenediammime both are obtained from Otto chemi make are recrystallized with Ethyl alcohol (china make ethanol) 99% pure ,Aniline (Merck make) was used as basic coating electrode material ,used after time to time distillation in Rotavapp to obtained it in pure form, to get the reproducible and revised results.
The Ch-instruments make elcrochemical workstation (CHI1089D) is used to prepare polymer film for further study. The Aniline (Merck make,Recrystallized, stored in Amber coloured glass bottle kept in Fridge at low temperature) 0.1 M (prepared in 0.5 M H_2SO_4 , a Dopant) is coated on Platinum RDE (Rotating disc electrode).The film of 98 cycles and of 0.7 ampere is used as a electrode to synthesized pPPD (Poly Para Phenylenediammine) and pOPD ((Poly Ortho Phenylene diammine).pPPD and pOPD are synthesized ,characterized and studied further for their electrochemical activity.The both monomers PPD and OPD (otto kemi make, recrystallised with ethyl alcohol and then used) solutions of different concentrations respectively of 1.25 mM,2.50 mM,5.0 mM,10.0 mM,20.0 mM

are prepared in 0.5M H_2SO_4 and every time freshly prepared aliquot of 100 ml is used so that to avoid the aerial oxidation of monomers.Every time aniline film of 98 cycles and 0.7 Ampere is prepared as a basic coating film(here called as standard PANI film) as an electrode and on which the above PPD and OPD concentrations are used to coat/polymerize for its two segments.The all above polymerization's are done at constant scan rate of 50 Mv/Seconds and Rotation speed of RDE is varied from 100 RPM to 3000 RPM.



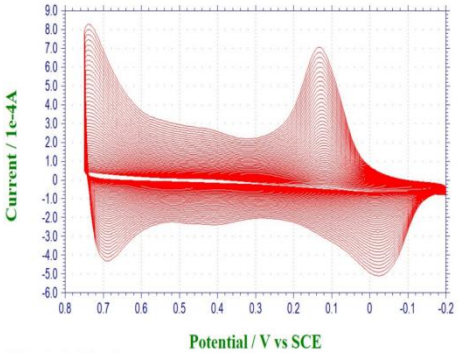


Figure 1: PPD on Pt RDE. and Figure 2: Standard PANI film of 0.7 milli Ampere Current.

Here figure 1 is the PPD coated on platinum working electrode showing no electrochemical activity and then the figure 2 is the PANI coated on Pt working electrode which is used as the base coat and on which when OPD or PPD is polymerized the smooth and easy polymerization is possible.

#polymerization of OPD as pOPD on above standard PANI film:

#1.25 mM OPD coated PANI.

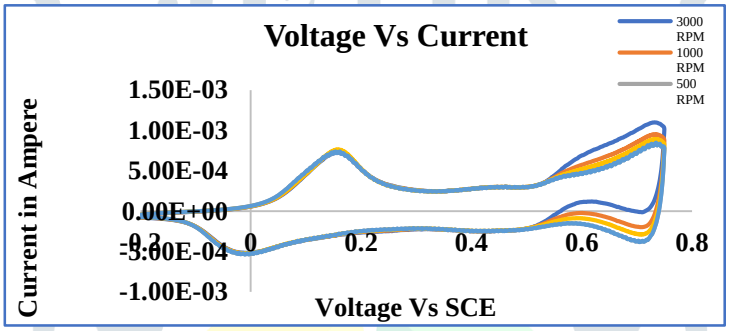


Figure 3: Plots of Current Vs Voltage for 1.25 mM OPD coated PANI (100 to 3000 RPM).

Sr. No.	Rotation Speed in RPM	Log Of RPM	Sqrt of RPM	Peak Potential (Ep) inVolts	Peak Current (Ip) in Ampere	Log of Ip	Charge (Q)in film In Coulomb
1	100	2.000000	1.4142	0.7280	0.0008140	-3.0482	0.001039
2	200	2.301030	1.5169	0.7279	0.0008487	-3.0233	0.001274
3	500	2.698970	1.6429	0.7290	0.0008929	-2.9889	0.001772
4	1000	3.000000	1.7321	0.7270	0.0009516	-2.9516	0.002295
5	3000	3.477121	1.8647	0.7290	0.0011020	-2.9041	0.003424

Table1: 1.25 mM OPD coated PANI RPM study.

When the 1.25 mM OPD solution is scanned at 50 V/Seconds with different rotations speed of the RDE ,it is found that the peaks are found at voltage around 0.170 volt which are not dominant and where no marginal changes in peak current found even after increasing the RPM of RDE but the peaks at 0.73 volt are dominant peaks and marginal as well as proportional changes are found in the Peak Current. From these peak current and log of peak current values as well as the RPM speed and Sqrt of RPM values ,the charge in the CV film from these parameters different relationships are found with respective to Levich equation.

The Peak Current is changes from 8.14E-4 Ampere for 100 RPM to 1.10E-3 Ampere and the charge in the film was generated from 1.03E-3 coulomb at100 RPM speed to 3.42E-3 coulomb at 3000 RPM speed.The increase in the charge is the symbol for double layer formation during polymerization.

#2.50 mM OPD coated PANI.

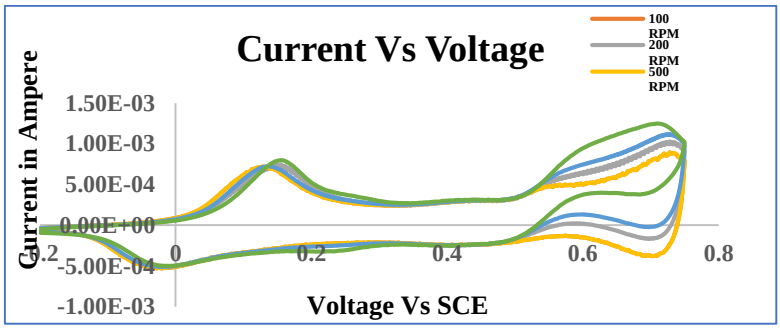


Figure 4: Plot of Current Vs Voltage for 2.5 mM OPD coated PANI (100 RPM to 3000 RPM).

Table2: 2.50 mM OPD coated PANI RPM study.

Sr. No.	Rotation Speed in RPM	Log Of RPM	Sqrt of RPM	Peak Potential (Ep)in Volts	Peak Current (Ip) in Ampere	Log of Ip	Charge (Q)in film In Coulomb
1	100	2.000000	1.4142	0.7280	0.0008950	-3.0482	0.001664
2	200	2.301030	1.5169	0.7279	0.0009478	-3.0233	0.002116
3	500	2.698970	1.6429	0.7290	0.0010260	-2.9889	0.002990
4	1000	3.000000	1.7321	0.7270	0.0011180	-2.9516	0.003926
5	3000	3.477121	1.8647	0.7290	0.0012470	-2.9041	0.005938

For 2.5 mM OPD coated PANI, As the rotation speed of RDE increases from 100 RPM to 3000 RPM the peak current increases from 8.95E-4 to 1. 24E-3 Ampere while the charge in film is increases from 1.66E-3 coulomb to 5.93E-3 coulomb. As more the species gathered at the electrode surface the more the conductance is found while the increase in the charge is suggesting the charge holding capacity of polymer film increases as the RPM of electrode increases.

#5.0 mM OPD coated PANI:

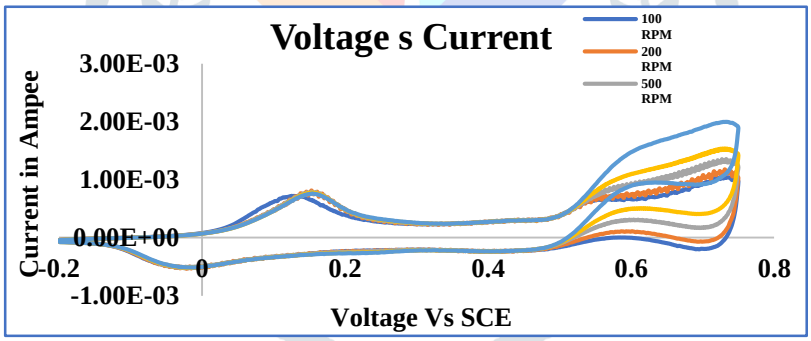


Figure 5: Plots of Current Vs Voltage 5mM OPD coated PANI (100 RPM to 3000 RPM)

Sr. No.	Rotation Speed in RPM	Log Of RPM	Sqrt of RPM	Peak Potential (Ep) in Volts	Peak Current (Ip) in Ampere	Log of Ip	Charge (Q)in film In Coulomb
1	100	2.0000	1.4142	0.7309	0.001040	-2.9830	0.003155
2	200	2.3010	1.5169	0.7310	0.001177	-2.9292	0.003990
3	500	2.6990	1.6429	0.7330	0.001356	-2.8677	0.005626
4	1000	3.0000	1.7321	0.7309	0.001538	-2.8130	0.007260
5	3000	3.4771	1.8647	0.7220	0.002000	-2.6990	0.010700

Table 3: 5 mM OPD coated PANI RPM study.

For 5 mM OPD coated PANI,the peak current increases from 1.04E-3 Ampere to 2.00E-3 Ampere and charge stored in film increases from 3.15E-3 coulomb to 1.07E-2 coulomb.

#10mM OPD coated on PANI:

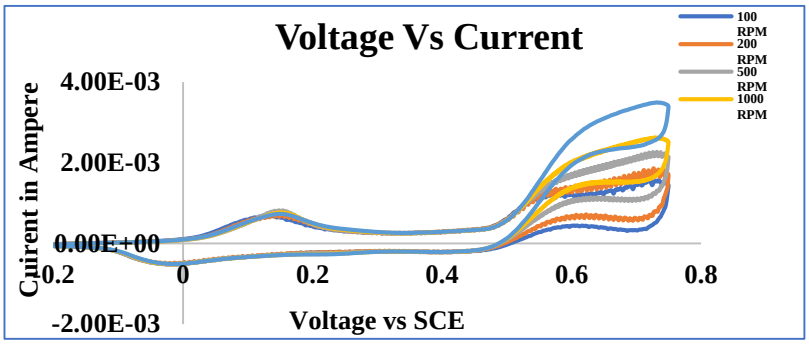


Figure 6: Plots of Current Vs Voltage 10 mM OPD coated PANI (100 RPM to 3000 RPM).

For 10mM OPD the peak current is increases from 1.56E-3 Ampere/cm^2 to 3.49E-3 Ampere/cm^2 and the charge stored in the film is increases from 8.21E-3 coulomb to 2.1E-2 coulomb.

Sr. No.	Rotation Speed RPM	log of RPM	Sqrt of RPM	Peak Potential (Ep) in volts	Peak Current (Ip) in Ampere	Log of Peak Current	Charge (Q) in Film in Coulomb
1	100	2.0000	1.4142	0.7349	0.001562	-2.8063	0.008213
2	200	2.3010	1.5169	0.7269	0.001860	-2.7305	0.003940
3	500	2.6990	1.6429	0.7320	0.002265	-2.6449	0.013340
4	1000	3.0000	1.7321	0.7290	0.002627	-2.5805	0.016310
5	3000	3.4771	1.8647	0.7330	0.003490	-2.4572	0.021960

Table 4: 10 mM OPD coated PANI RPM study.

#20 mM OPD coated PANI.

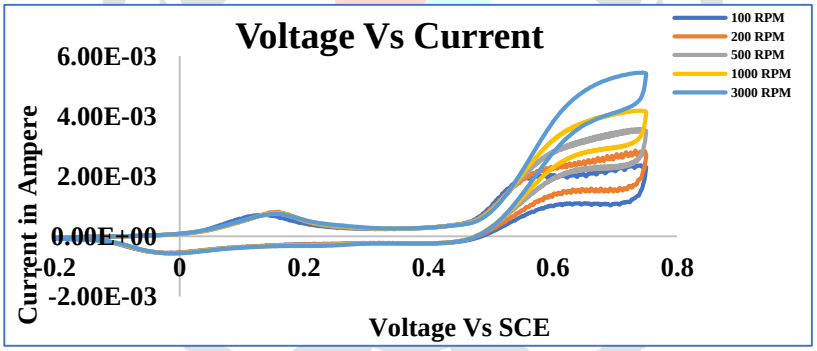


Figure 7: Plots of Current Vs Voltage 20 mM OPD coated PANI (100 RPM to 3000 RPM).

Sr. No.	Rotation Speed RPM	log of RPM	Sqrt of RPM	Peak Potential (Ep) in volts	Peak Current (Ip) in Ampere	Log of Peak Current	Charge (Q) in Film in Coulomb
1	100	2.0000	1.4142	0.7419	0.002361	-2.6269	0.01486
2	200	2.3010	1.5169	0.7328	0.002863	-2.5432	0.01781
3	500	2.6990	1.6429	0.7379	0.003582	-2.4459	0.02300
4	1000	3.0000	1.7321	0.7390	0.004188	-2.3780	0.02706
5	3000	3.4771	1.8647	0.7338	0.005446	-2.2639	0.03475

Table 5: 20 mM OPD coated PANI RPM study.

For 20 mM OPD the peak current increases from 2.36E-3 Ampere to 5.44E-3 Ampere and the charge stored in film is increases from 1.48E-2 coulomb to 3.47E-2 coulomb.

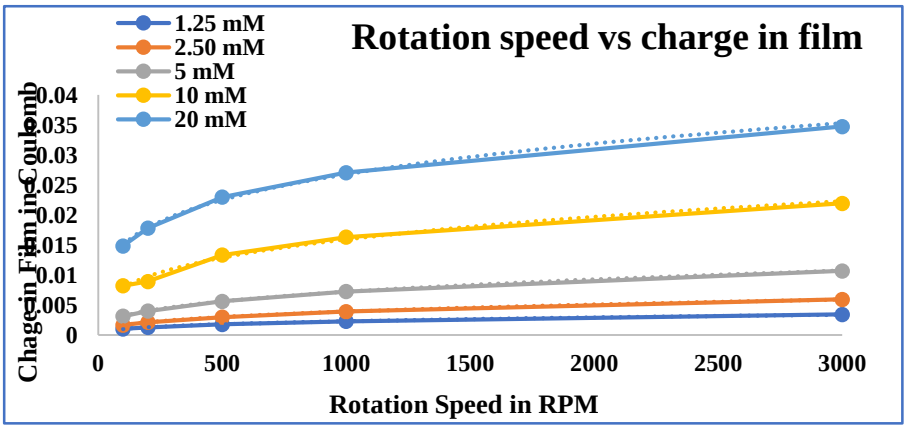


Figure 8: Rotation speed in RPM Vs charge in film, 20 mM OPD coated PANI 100 RPM to 3000 RPM.

Sr. No.	Slope	Exponent	Regression Factor	Relation between Charge and Speed
1	0.0047	0.2512	0.9979	Exponential
2	0.0005	0.4819	0.9140	
3	0.0006	0.3615	0.9998	
4	0.0003	0.3761	0.9997	
5	0.0002	0.3540	0.9987	

Table 6: Observation table for Figure 8.

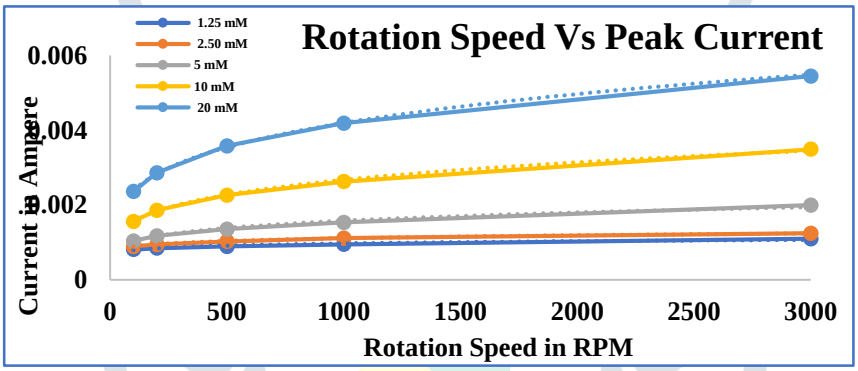


Figure 9: Plot of rotation speed Vs Peak current for OPD 100 RPM to 3000 RPM.

Sr.No.	Slope	Exponent	Regression Factor	Relation between Charge and RPM
1	0.0008	-0.2436	0.9989	Exponential
2	0.0005	-0.2326	0.9985	
3	0.0004	-0.1884	0.9907	
4	0.0006	0.0986	0.9957	
5	0.0005	0.0860	0.9559	

Table 7: Observation table for Figure 9.

#Concentration effect for OPD at specific Rotation speed (100 RPM to 3000 RPM).

↓ Concentration of OPD used in mM (milli molar)	→ Rotation Speed in RPM	Charge (Q) at 100	Charge (Q) at 200	Charge (Q) at 500	Charge (Q)at 1000	Charge (Q)at 3000
1.25 mM		0.001039	0.001274	0.001772	0.002295	0.03424
2.5 mM		0.001664	0.002116	0.002990	0.003926	0.005938
5 mM		0.003155	0.003990	0.005626	0.007260	0.010700
10 mM		0.003940	0.008213	0.013340	0.016310	0.021960
20 mM		0.01486	0.01781	0.02300	0.02706	0.03475

Table 8: Charge on Concentration change at specific RPM.

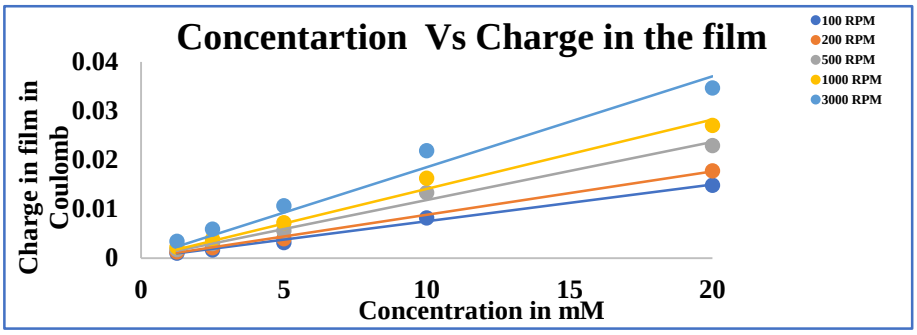


Figure 10:Plots for Concentration Vs charge in film at specific rotation speed.

Sr.No.	Slope	Intercept	Regression Factor	Relation between Charge and Speed
1	0.0008	0	0.9931	linear
2	0.0009		0.9987	
3	0.0012		0.9908	
4	0.0014		0.9844	
5	0.0019		0.9840	

Table 9: Observation table for figure 10.

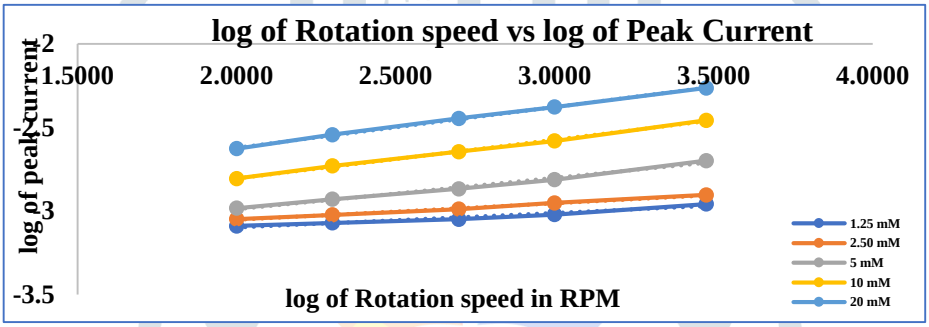


Figure 11: Plots of log of rotation speed vs log of peak current for 1.25 mM OPD to 20 mM OPD.

Sr.No.	Slope	intercept	Regression Factor	Relation between Charge and Speed
1	0.0860	-3.2716	0.9559	linear
2	0.0986	-3.2490	0.9957	
3	0.1884	-3.3661	0.9907	
4	0.2326	-3.2708	0.9985	
5	0.2436	-3.1082	0.9989	

Table 10: Observation Table for Figure 11.

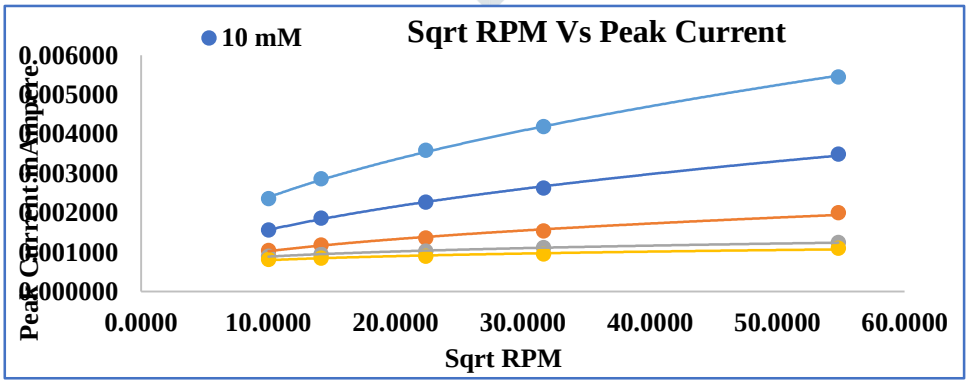


Figure 12: Plots of Sqrt RPM vs Peak Current.

Sr. No.	Slope	intercept	Regression Factor	Relation between Charge and Speed
1	0.0008	0.4872	0.9989	Exponential
2	0.0005	0.4652	0.9985	
3	0.0004	0.3767	0.9907	
4	0.0006	0.1972	0.9895	
5	0.0005	0.1735	0.9559	

Table 11: Observation Table for Figure 12.

#Polymerization of PPD as pPPD on standard PANI film(figure1):

#1.25 mM PPD coated PANI.

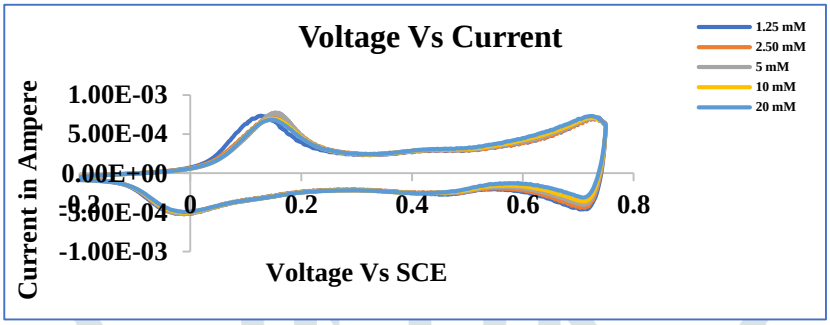


Figure 13: Plot of Voltage Vs current for 1.25 mM PPD coated PANI (100 RPM to 3000 RPM).

Here for 1.25 mM PPD coated PANI, the Peak current is changes from 7.239E-4 Ampere to 7.31E-4 Ampere.The charge in the polymer film is changes from 5.7E-4 coulomb to 1.27E-3 coulomb.

Sr.No.	Rotation Speed RPM	log of RPM	Sqrt of RPM	Peak Potential (Ep)in volts	Peak Current (Ip) in Ampere	Log of Ip	Charge(Q) in film in Coulomb
1	100	2.0000	1.4142	0.7239	0.0007239	-3.1403	0.00057
2	200	2.3010	1.5169	0.7281	0.0007269	-3.1385	0.00071
3	500	2.6990	1.6429	0.7271	0.0007289	-3.1373	0.00088
4	1000	3.0000	1.7321	0.7231	0.0007296	-3.1369	0.00104
5	3000	3.4771	1.8647	0.7220	0.0007313	-3.1359	0.00127

Table 12:RPM study 1.25 mM PPD coated PANI.

#2.50 mM PPD coated PANI.

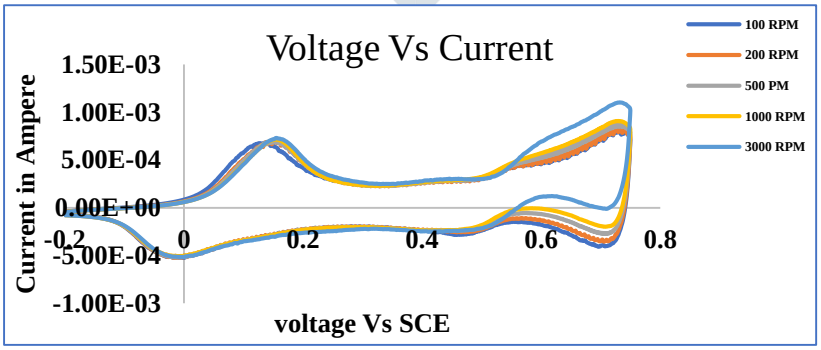


Figure 14: Plot of Voltage Vs current (100 RPM to 3000 RPM) for 2.50 mM PPD coated PANI.

Sr. No.	Rotation Speed in RPM	log of RPM	Squrt of RPM	Peak Potential (Ep)	Peak Current(Ip)	log Ip	Charge(Q) in film in Coulomb
1	100	2.0000	1.4142	0.7318	0.000730	-3.1367	0.001161
2	200	2.3010	1.5169	0.7260	0.000832	-3.0797	0.001453

3	500	2.6990	1.6429	0.7213	0.000877	-3.0569	0.001973
4	1000	3.0000	1.7321	0.7270	0.000909	-3.0413	0.002204
5	3000	3.4771	1.8647	0.7230	0.000980	-3.0086	0.003061

Table 13: RPM study 2.50 mM PPD coated PANI.

For 2.5 mM PPD coated PANI the peak current is changes from 7.30E-4 Ampere to 9.80E-4 Ampere and the charge stored in the film is changes from 1.161E-3 coulomb to 3.061E-3 coulomb.

#5 mM PPD coated PANI.

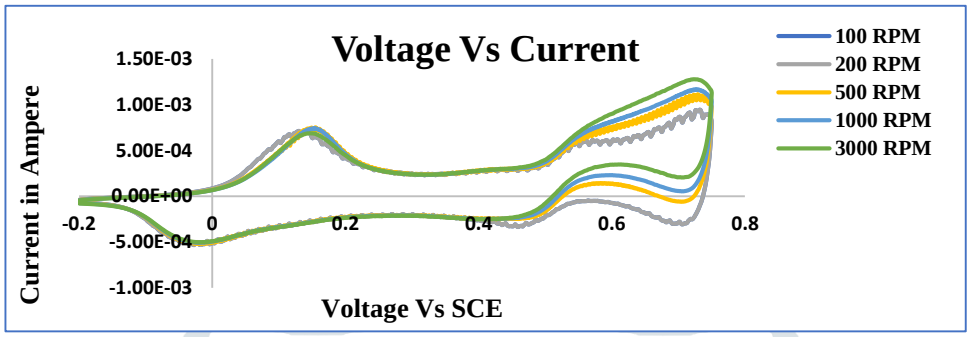


Figure 15: Plot of Voltage Vs current for 5.0 mM PPD coated PANI (100 RPM to 3000 RPM).

Sr. No.	Rotation Speed RPM	log of RPM	Squrt of RPM	Peak Potential (Ep) in volts	Peak Current(Ip) in ampere	Log of Peak Current	Charge(Q) in film in coulomb
1	100	2.0000	1.4142	0.7320	0.0009457	-3.0242	0.00224
2	200	2.3010	1.5169	0.7290	0.0010000	-3.0000	0.00290
3	500	2.6990	1.6429	0.7290	0.0011100	-2.9547	0.00391
4	1000	3.0000	1.7321	0.7280	0.0011700	-2.9318	0.00470
5	3000	3.4771	1.8647	0.7235	0.0012270	-2.9112	0.00571

Table 14:RPM study 5.0 mM PPD coated PANI.

For 5 mM PPD coated PANI the peak current is changes from 9.45E-4 Ampere to 1.22E-3 Ampere and the charge stored in the film is changes from 2.24E-3 coulomb to 5.71E-3 coulomb.

#10 mM PPD coated PANI.

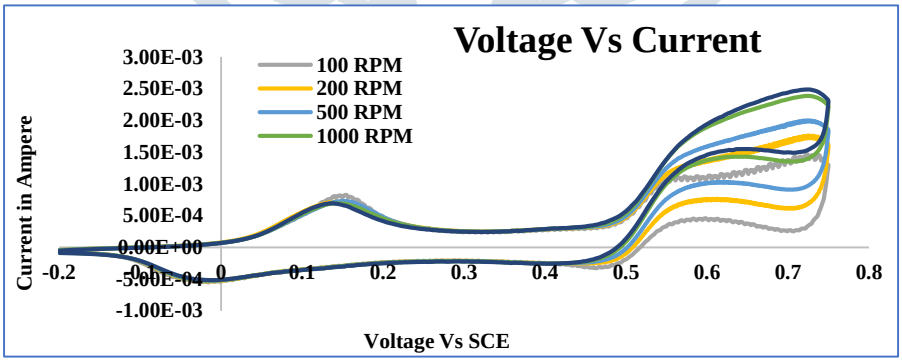


Figure 16: Plot of Voltage Vs current (100 RPM to 3000 RPM) for 10 mM PPD coated PANI.

For 10mM PPD coated PANI the peak current is changes from 1.47E-3 Ampere to 2.30E-3 Ampere and the charge stored in the film is changes from 5.21E-3 Coulomb to 1.50E-2 Coulomb.

Sr. No.	Rotation Speed RPM	log of RPM	Squrt of RPM	Peak Potential(Ep) in volts	Peak Current (Ip) in Ampere	Log of Ip	Charge(Q) in film in coulomb
1	100	2.0000	1.4142	0.7238	0.001470	-2.8327	0.00521

2	200	2.3010	1.5169	0.7237	0.001571	-2.8038	0.00691
3	500	2.6990	1.6429	0.7249	0.001761	-2.7542	0.00956
4	1000	3.0000	1.7321	0.7250	0.002004	-2.6981	0.01171
5	3000	3.4771	1.8647	0.7250	0.002300	-2.6383	0.01500

Table 15:RPM study 10 mM PPD coated PANI.

#20 mM PPD coated PANI.

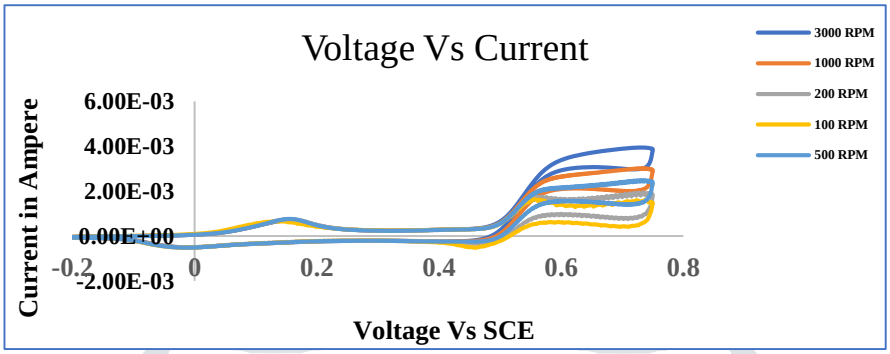


Figure 17: Plot of Voltage Vs current for 20 mM PPD coated PANI (100 RPM to 3000 RPM).

Sr.No.	Rotation Speed RPM	log of RPM	Squrt of RPM	Peak Potential (Ep)in volts	Peak Current (Ip)in Ampere	Log of Ip	Charge(Q)in film in Coulomb
1	100	2.0000	1.4142	0.7372	0.0015920	-2.7981	0.00869
2	200	2.3010	1.5169	0.7349	0.0019390	-2.7124	0.01147
3	500	2.6990	1.6429	0.7369	0.0024880	-2.6041	0.01670
4	1000	3.0000	1.7321	0.7339	0.0030160	-2.5206	0.02102
5	3000	3.4771	1.8647	0.7290	0.0039430	-2.4042	0.02826

Table 16:RPM study 20 mM PPD coated PANI.

For 20 mM PPD coated PANI the peak current is changes from 1.59E-3 Ampere to 3.94E-3 Ampere and the charge stored in the film is changes from 8.69E-3 Coulomb to 2.82E-2 Coulomb.

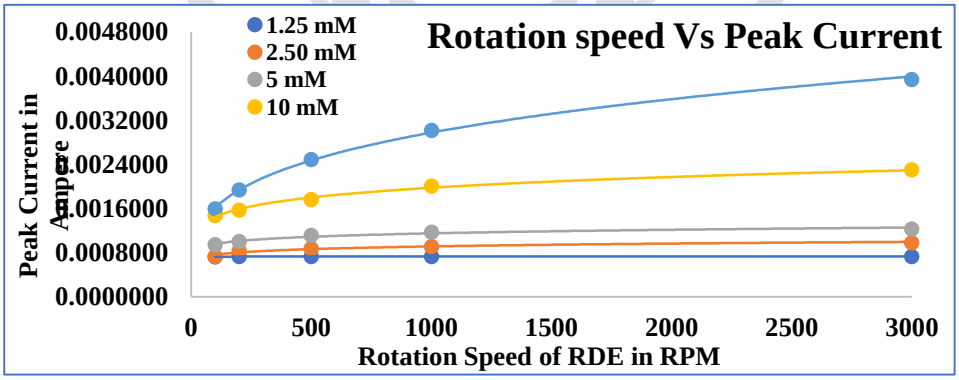


Figure 18: Plot of Rotation speed of RDE vs Peak current.

Sr No.	Slope	Exponent	Regression constant	Relationship Between Ip and RPM
1	0.0007	0.0028	0.9330	Exponential
2	0.0005	0.0797	0.9299	
3	0.0007	0.0799	0.9687	
4	0.0008	0.1354	0.9920	
5	0.0005	0.2676	0.9991	

Table 17: Observation table for Figure 18.

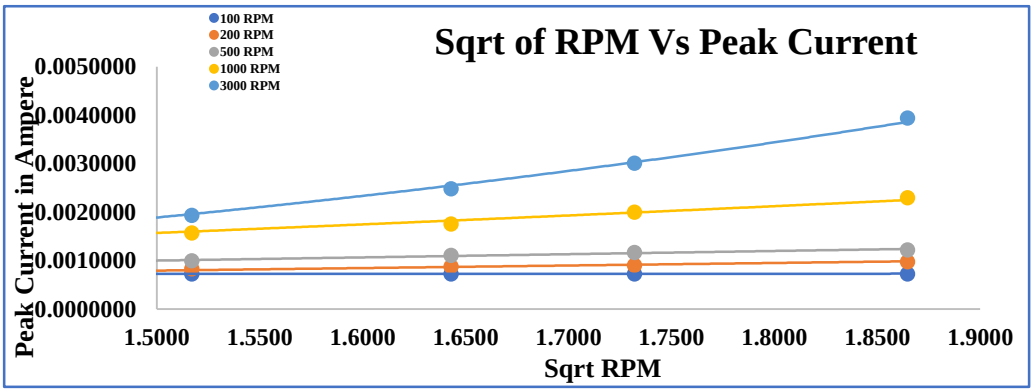


Figure 19: Plot of Sqrt RPM vs Peak current.

Sr. No.	Slope	Exponent	Regression Constant	Relation Betn Sqrt RPM and Ip
1	0.0005	3.284	0.9968	**Exponential**
2	0.0008	1.6508	0.9765	
3	0.0007	0.9900	0.9862	
4	0.0005	0.9930	0.9564	
5	0.0007	0.0353	0.9646	

Table 18: Observation table for figure 19.

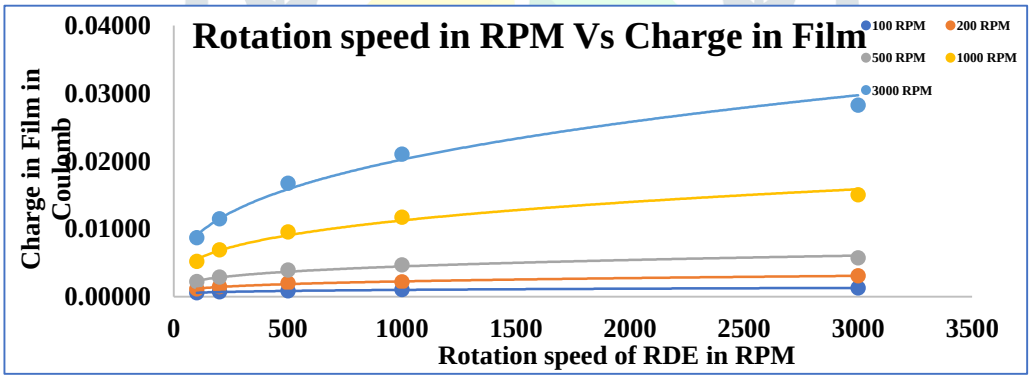


Figure 20 : Rotation speed of RDE in RPM vs Charge in film.

Sr. No.	Slope	Exponent	Regression constant	Relationship Between RPM and Charge in Film
1	0.0002	0.2347	0.9915	**Exponential**
2	0.0003	0.2802	0.9920	
3	0.0007	0.2776	0.9777	
4	0.0013	0.3119	0.9851	
5	0.0018	0.3505	0.9908	

Table 19:Observation table for figure 20.

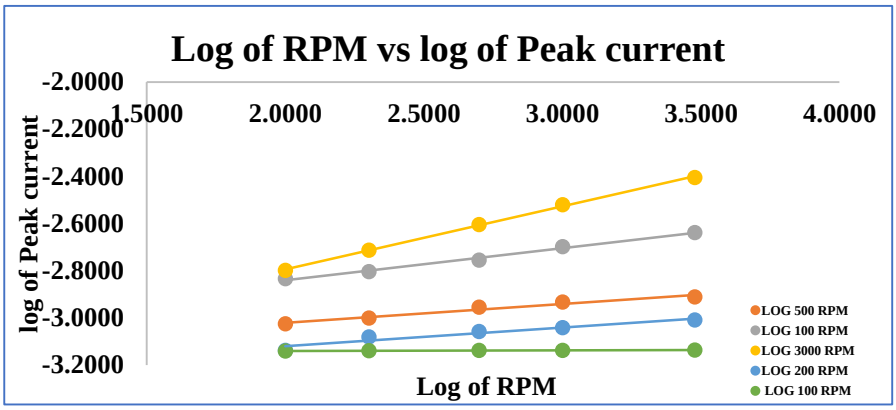


Figure 21 : log of RPM vs log of peak current for PPD 1.25 mM to 20.0 mM PPD coated PANI.

Sr No.	Slope	Intercept	Regression constant	Relationship Between RPM and Charge in Film
1	0.0028	-3.1454	0.9330	linear
2	0.0797	-3.2794	0.9299	
3	0.0799	-3.1796	0.9687	
4	0.1354	-3.1104	0.9920	
5	0.2676	-3.3291	0.9991	

Table 20:Observation table for figure 21.

#Concentration of PPD Vs Charge in film at specific RPM

Rotation Speed → / Concentration in mM ↓	Q at 100 RPM	Q at 200 RPM	Q at 500 RPM	Q at 1000 RPM	Q at 3000 RPM
1.25	0.000570	0.000710	0.000880	0.001040	0.001270
2.5	0.001161	0.001453	0.001973	0.002204	0.003061
5	0.002240	0.002900	0.003910	0.004700	0.005710
10	0.005210	0.006910	0.009560	0.011710	0.015000
20	0.008690	0.011470	0.016700	0.021020	0.028260

Table 21:Concentration and change in charge in film at specific RPM.

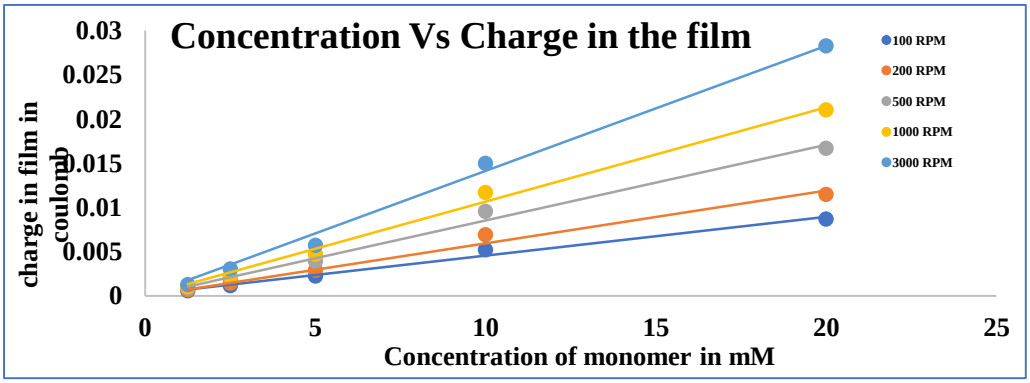


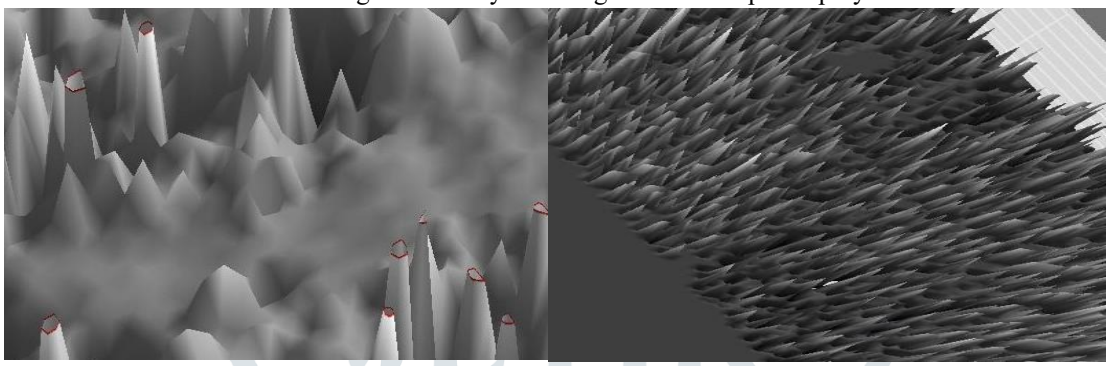
Figure 22:Plots of the concentration Vs charge in film at specific RPM.

Sr No.	Slope	intercept	Regression constant	Relationship Between RPM and Charge in Film

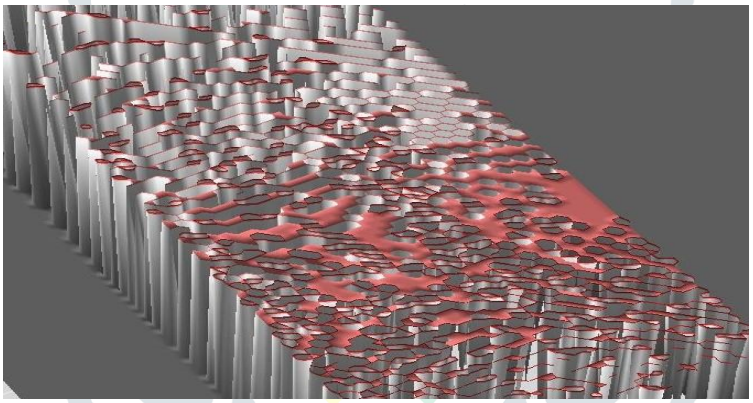
1	0.0004	0	0.9881	**linear**
2	0.0006		0.9861	
3	0.0009		0.9920	
4	0.0011		0.9932	
5	0.0014		0.9939	

Table 22:observation table for figure 21.

Atomic Force Microscopic (AFM) study: The Atomic Force microscopy is used to identify the topography of OPD coated Sample and PPD coated sample.The Tapping mode is used here where the cantilever is oscillator at its resonant frequency near to the surface and the sample topography measures here.The AFM used is the nanosurf Easyscan 2 model.The AFM images scanned for 3 different surfaces (a)OPD coated PANI 3D view shows the bulky coatings of OPD The image (b) is the PANI coated on Platinum plate.while the image (C) is the PPD coated PANI indicating the sideways bonding between the pPPD polymer threads.



(a) (b)



(C)

Figure 23 :a) 3D view AFM image of OPD coated PANI, b) 3D view AFM image of PANI coated on Platinum plate, c) 3D view AFM image of PPD coated PANI.

#Contact angle Measurement: The Contact angle is measured on OPD (10 mM) coated PANI.It is found that the material is highly hydrophilic and not able to measure the contact angle with water, then the contact angle is measured here for silicone oil on the polymer coated surfaces.The contact angle is found as hydrophobic -as Follows:

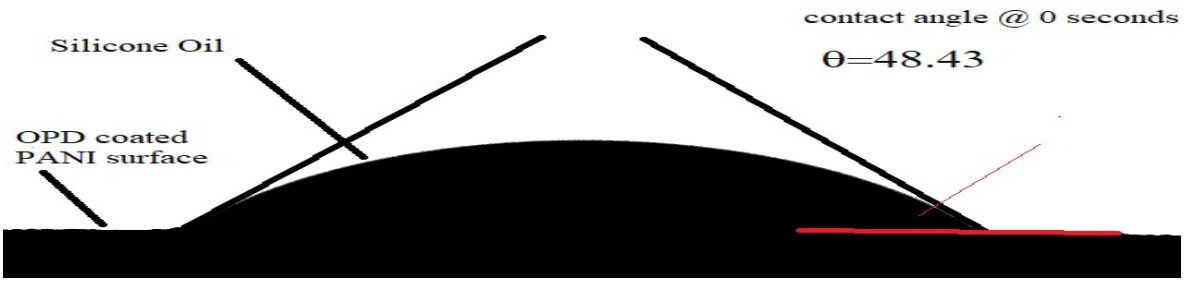


Figure 24: Contact angle measured on OPD coated PANI surface-1st image at 0 seconds time image .

Figure 25: Contact angle measured on OPD coated PANI surface-100th image.

The contact angle is found as around 50 for oil on the PPD coated surface and OPD coated surface indicates the material is hydrophobic and the the angle is decreases with time as the 100 th image is found angle as 30.

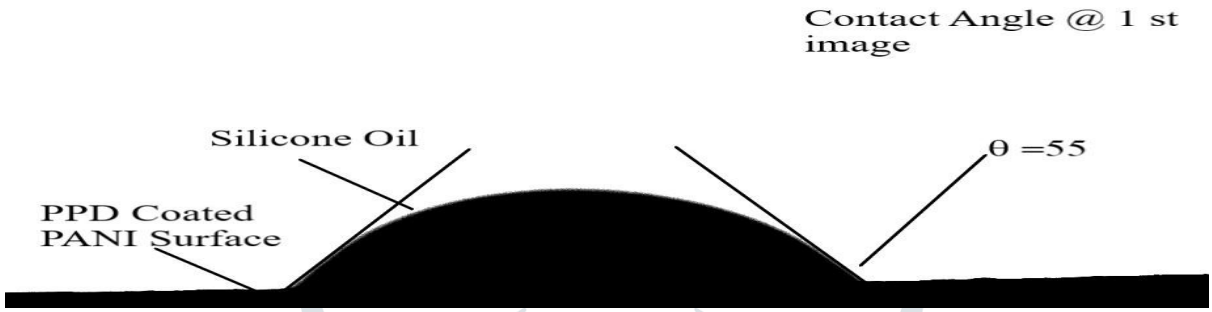


Figure 26: PPD coated PANI 1st image-at 0 seconds image.

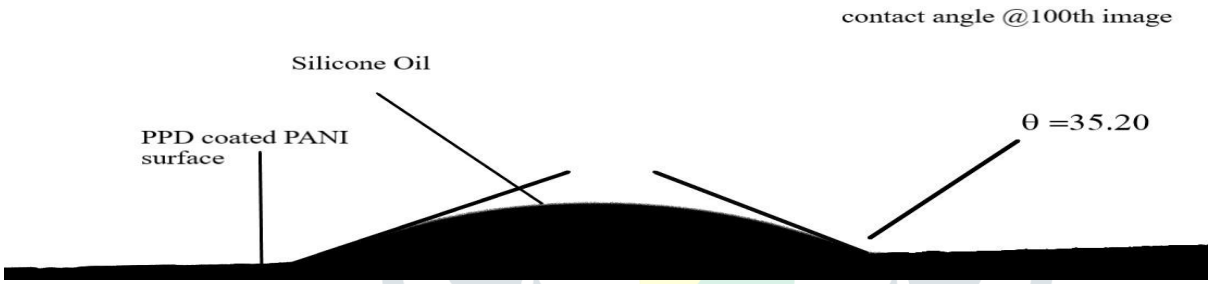


Figure 27 : PPD coated PANI 100 th image.

Sr.No.	Subtrate	liquid	Image no.	Contact Angle
1	OPD coated PANI	Silicone Oil	1st	48.5
2	OPD coated PANI	Silicone Oil	100th	30
3	PPD coated PANI	Silicone Oil	1st	55
4	PPD coated PANI	Silicone Oil	100th	35

Table 23: Observation Table for Contact angle measurement.

Conclusion:

I. During the OPD coated PANI polymerization study the peak currents are found to increase as the rotation speed of RDE increases from 100 RPM to 3000 RPM a) for 1.25 mM monomer OPD- 8.14E-4 Ampere to 1.10E-3 Ampere, b) for 2.50 mM monomer OPD-8.95E-4 Ampere to 1.24E-3 Ampere, c)for 5 mM monomer OPD-1.04E-3 Ampere to 2.00E-3 Ampere d) for 10 mM monomer OPD-1.56E-3 Ampere to 3.49E3 Ampere, e) for 20 mM monomer OPD-2.36E--3 Ampere to 5.44E-3 Ampere.

II. During the OPD coated PANI polymerization study the charge (Q) stored in the polymer film are found to increase as the rotation speed of RDE increases from 100 RPM to 3000 RPM a) for 1.25 mM monomer OPD-1.03E-3 coulomb to 3.42E-3 coulomb, b) for 2.50 mM monomer OPD-1.66E-3 coulomb to 5.93E-3 coulomb, c)for 5 mM monomer OPD-3.15E-3 coulomb to 1.07E-2 coulomb d) for 10 mM monomer OPD-8.21E-3 coulomb to 2.19E-2 coulomb, e) for 20 mM monomer OPD-1.48E-2 coulomb to 3.47E-2 coulomb.

III. During the PPD coated PANI polymerization study the peak currents are found to increase as the rotation speed of RDE increases from 100 RPM to 3000 RPM a) for 1.25 mM monomer PPD- 7.23E-4 Ampere to 7.31E-4 Ampere, b) for 2.50 mM monomer PPD-7.30E-4 Ampere to 9.80E-4 Ampere, c)for 5 mM monomer PPD-9.45E-4 Ampere to 1.22E-3 Ampere d) for 10 mM monomer PPD-1.47E-3 Ampere to 2.30E-3 Ampere, e) for 20 mM monomer PPD-1.59E-3 Ampere to 3.94E-3 Ampere.

IV. During the PPD coated PANI polymerization study the charge (Q) stored in the polymer film are found to increase as the rotation speed of RDE increases from 100 RPM to 3000 RPM a) for 1.25 mM monomer PPD-5.7E-4 coulomb to 1.27E-3 coulomb, b) for 2.50 mM monomer PPD-1.16E-3 coulomb to 3.06E-3 coulomb, c)for 5 mM monomer PPD-2.24E-3 coulomb to 5.71E-2 coulomb d) for 10 mM monomer PPD-5.21E-3 coulomb to 1.50E-2 coulomb, e) for 20 mM monomer PPD-8.69E-3 coulomb to 2.82E-2 coulomb.

V. In AFM study of the OPD and PPD coated PANI ,the side-wise /Parallel p-π,p-π bonding is found.

VI. For the OPD coated PANI the contact angle is found 48.5 and PPD coated PANI it is found 55 and both substrate are found hydrophobic.The contact angle is changes drastically with time and decreased up to 30 for pOPD and 35 for pPPD after 10 seconds.

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