

# Aim: Poly (Aniline Co- M- Nitro Aniline) Synthesis and Characterization Doped with Inorganic Acids

Memane Archana Dada

Assistant Professor, PKTCK, Pune, India

Author Email: archanamemane2463@gmail.com

**Abstract**—The current study describes the synthesis and characterization of poly (anilineco-metanitroaniline) using different mineral acids. Poly (aniline co-meta nitro aniline) was created at room temperature using the chemical oxidative polymerization of monomer aniline and co-monomer meta nitro aniline. As a dopant, hydrochloric acid, sulfuric acid, and perchloric acid were utilized, coupled with acrylic acid as a soft templet. Analytical techniques such as FTIR, UV- DRS, and XRD were used to analyze the synthesized Poly (aniline co - Meta nitro aniline).

**Keywords:** Oxidativepolymerization, dopant, mineralacidandsofttemplet.

## I. INTRODUCTION

**POLYMERS:** A polymer is a big molecule, or macromolecule, made up of many repeating subunits known as monomers. Because of their many qualities, both synthetic and natural polymers play an important and pervasive role in daily life. Polymers span from well-known synthetic plastics like polystyrene to natural biopolymers like DNA and proteins, which are essential to biological structure and function. Polymerization of numerous monomers results in the formation of polymers, both natural and manufactured. Their enormous molecular mass in comparison to small molecule compounds results in unique physical features such as toughness.

**POLYANILINE:** Polyaniline (PANI) is a semi-flexible rod polymer. Although the chemical itself has been discussed for over 150 years; polyaniline has only recently attracted the scientific community's interest. The rediscovery of high electrical conductivity has sparked this interest. Polyniline is a conducting polymer and organic semiconductor with numerous appealing processing features. Polyaniline is one of the most researched conducting polymers in the last 50 years due to its rich chemistry. Polyaniline (PANI) comes in a number of forms with varying chemical and physical properties.

The most common green protoned emeraldine possesses conductivity of the order of  $100 \text{ scm}^{-1}$ , which is many orders of magnitude higher than that of common polymers (e.g.  $10^{-9} \text{ Scm}^{-1}$ ) but lower than that of usual metals ( $>10^{-4} \text{ S cm}^{-1}$ ). When protonated PANI (e.g., PANI hydrochloride) is treated with ammonium hydroxide, it transforms to a nonconducting blue emeraldine base. In an alkaline media, polyaniline (emeraldine) salt is deprotonated to polyaniline (emeraldine) base. It is an anion, such as chloride.

Polymerized from the low-cost aniline monomer, poluaniline can be found in one of three idealized oxidation states:

**(Per)nigraniline** blue/violet ( $\text{C}_6\text{H}_4\text{N}$ ) $_n$  Leucoemeraldine with  $n=1, m=0$  is the fully reduced state. Pernigraniline is a fully oxidized state ( $n=0, m=1$ ) containing links rather than amine linkages. According to research, the majority of polyaniline forms are one of the three states or physical combinations of these components. The emeraldine ( $n=m=0.5$ ) form of polyaniline is neutral; if doped (protonated), it is known as emeraldine salt (ES), with the imine nitrogens protonated by an acid. Protonation aids in the delocalization of the most beneficial diiminoquinone-diaminobenzene state. Emeraldine base is regarded as the most practical form of polyaniline due to its high temperature stability and the fact that, when combined with acid, the resulting emeraldine salt form of polyaniline is highly electrically conductive. Even when doped with an acid, leucoemeraldine and pernigraniline are weak conductors.

Only in an acidic media, where aniline occurs as an anilinium cation, can aniline be efficiently polymerized. In the synthesis of PANI, a variety of inorganic and organic acids of varying concentrations were utilized; the resulting PANI, protonated with various acids, differs in solubility, conductivity, and stability. The color shift caused by polyaniline in its various oxidation states or doping levels. The electrical conductivity of emeraldine is increased by 10 orders of magnitude when it is treated with acids. Oxidation of leucoemeraldine yields the same substance. The oxidation of leucoemeraldine is chosen for the handling of solid aniline salt. From the standpoint of hazardous risks, the handling of solid aniline salt is preferable to liquid aniline salt.

The stoichiometric peroxydisulfate/aniline ratio 1.25 is recommended to limit the occurrence of residual aniline and to achieve the highest PANI yield. Polyaniline is more noble than copper and somewhat less noble than silver, which serves as the foundation for its use in printed circuit board fabrication (as a final finish) and corrosion resistance.

• **Polyaniline Properties:** Higher molar mass polyaniline is formed at lower reaction temperatures, but molar mass has little effect on the polymer's electrical properties. We used ambient temperature for this investigation despite the uncertain definition of such settings. Because temperature increased throughout their activity, which was dependent on the surface-to-volume ratio of the experimental setup; exact temperature control was not attempted. The influence of reaction temperature on PANI conductivity was measured and discussed. In the presence of increased HCL, polymerization occurs at a greater activity level.

• **Polyaniline General Applications:** Polyaniline and other conducting polymers such as polythiophene, polypyrrole, and PEDOT/PSS have application potential due to their light weight, conductivity, mechanical flexibility, and low cost. Polyaniline is particularly appealing since it is relatively cheap, has three distinct oxidation states with varied hues, and has an acid/base doping response. Polyaniline is appealing for acid/base chemical vapour sensors, super capacitors, and biosensors because to its latter characteristic. The material's many hues, charges, and conformations make it promising for applications such as super capacitors and electrochromics. They can be used to make electrically conductive yarns, antistatic coatings, electromagnetic shielding, and flexible electrodes. Antistatics, charge dissipation or electrostatic dispersive (ESD) coating and blends, electromagnetic interference shielding (EMI), anticorrosive coating, hole injection layers, transparent conductors, indium tin oxide are all attractive domains for current and potential polyaniline applications.

Replacements, actuators, chemical vapour and solution based sensors, electrochromic coating (for color change windows, mirrors, etc.), PEDOT-PSS replacements, toxic metal recovery, catalysis, fuel cells, and active electronic components such as non-volatile memory. **Copolymerization:-** Copolymerization occurs when like molecules come together in a random or alternating sequence.

Copolymers of online with m-nitroaniline [poly (aniline-co-m-nitroaniline)] for example, were easily produced in various molar ratios of co-monomers by chemical and electrochemical polymerization rate decreased with an increasing ratio of m-nitroaniline in monomer (Ding et al., 2012).

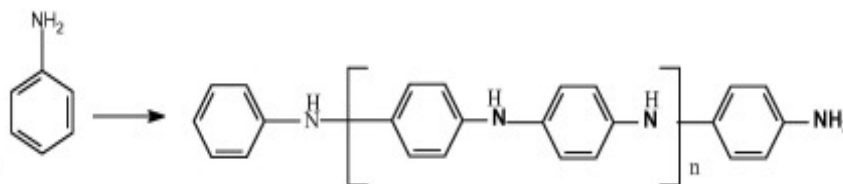
Chemical oxidative copolymerization of aniline and o-chloroaniline with 4m ratios was achieved using ammonium persulphate as an oxidant in HCl medium at 0-4°C (Broker, 2012).

## II. CHEMICAL MATERIALS AND METHODS

All chemicals used were A.R grade and were utilized without additional purification.

1. Ammonium per sulphate (APS), (Qualigen)
2. HCl (Hydrochloric acid), H<sub>2</sub>SO<sub>4</sub> (Sulphuric acid), HClO<sub>4</sub> (Perchloric acid)
- Distilled water
4. (Qualigen) aniline
5. Aniline was distilled before application of acrylic acid (S.D.Fine).

**Polyaniline Synthesis:** To make Polyaniline, 1ml of aniline (monomer solution) was placed in a beaker and 2ml of strong hydrochloric acid was added. 30ml of distilled water was added to it, which was stored in an ice bath to maintain a temperature of roughly 0-50 C. This entire system was a Kepton magnetic stirrer for stirring. A further 1ml of acrylic acid was added. 1.14gm of APS was dissolved in 10ml of distilled water and dropped into the aforesaid solution dropwise. Conc. HCl was used as a dopant in this reaction combination. Reaction was carried out for half an hour at 0-50°C. The procedure was repeated until a green color appeared, signifying the creation of Polyaniline.

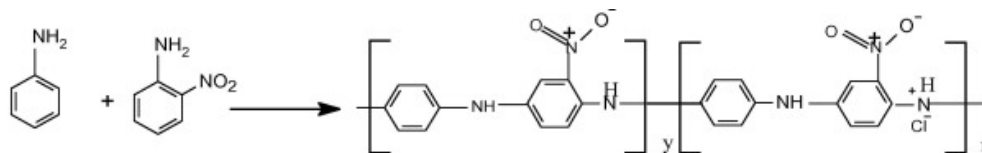


### 3.2 Synthesis of poly (aniline-Co-m-nitroaniline)

In the instance of poly (aniline-Co-m-nitroaniline) preparation, 1.8ml aniline and 2ml conc. hcl or conc. H<sub>2</sub>SO<sub>4</sub> were dissolved in 100 ml distilled water.

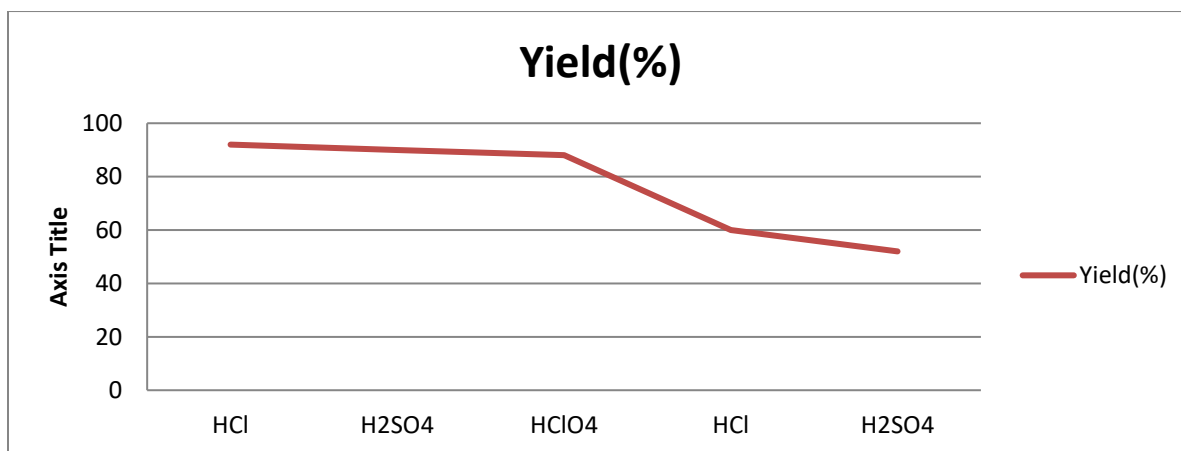
Then 1ml acrylic acid was added to it dropwise. 2.29gm APS dissolved in 5.2ml H<sub>2</sub>O and dropped into above solution. The solution initially turns white before changing to a rich blue color. Then, to the aforesaid solution, add 0.27 gm m-Nitroaniline. Distilled water can be used to dilute up to 200ml. The solution was precooled at 0°C, and the entire reaction was carried out at temperatures ranging from 0 to 50 degrees Celsius.

The reaction mixture was continuously swirled on a magnetic stirrer with a magnetic needle for about 3 hours to obtain the result, which is deep green in color, and was then analyzed for conformation using various analytical techniques.



#### IV. RESULTS AND DISCUSSION

Polymer	Soft Templet	Monomer	Co-monomer	Dopant	Yield(%)
Poly(aniline-co-m-nitroaniline)	Acrylic Acid	1:0:1	0-50 <sup>0C</sup>	HCl	92
				H <sub>2</sub> SO <sub>4</sub>	90
				HClO <sub>4</sub>	88
		1:0:2	RT	HCl	60
				H <sub>2</sub> SO <sub>4</sub>	52
				HClO <sub>4</sub>	48



#### V. CONCLUSION

Polyaniline and co metanitraaniline can be synthesized by oxidative polymerization method. Morphology of polymer material was not affected by dopant used. Polymerisation reaction rate was affected by temperature. HCl doped polymer has less band gap than the H<sub>2</sub>SO<sub>4</sub> doped polymer while HClO<sub>4</sub> doped polymers show large band gap. Hence HCl doped polymers show good conductivity than other acid dopant. Use of templet on conductivity.

## REFERENCES

1. V. V. Chabukswar; S. Pethkar; A. A. Athwale, Acrylic acid doped polyaniline as an ammonia sensor, Sensors and Actuators B77 (2001) 657-663.
2. A.Mekki,N.Joshi,A.Singh,Z.Salmi,P.Jha,P.Decorse,S.L.Troung,R.Mahmoud,M.M.Chehimi,D.K. Aswal, S. K. Gupta, Org.Electr., 2014, 15, 71.
3. S.Sathiyarayanam;S.Muthkrishnan;G.Venkatachari,ElectrochimActa2006,51,6313.
4. S. K. Dhawan;D. Kumar; M. K. Ram;S. Chandra; D.C. Trivedi, Application of conducting polyaniline as sensor material for ammonia, Sensor and ActuatorsB, 40 (1997)99-103