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OXIDATION POLYMERIZATION OF ANYLINE

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ABSTRACT: In the study, polyaniline (PANI) was synthesized using the chemical oxidation method of aniline. Identification of the obtained polymer was carried out by analyzing its IR spectra. The effect of various factors on the yield of PANI formation, including reagent concentration, oxidizing type, solution pH environment, temperature was studied.

KEYWORDS: aniline, oxidizing, polymerization, reaction rate, polymerization product, polyaniline, protonating agent.

INTRODUCTION

Polyaniline (PANI) is a type of electrically conductive polymer that exhibits ionic conductivity and electronic conductivity in the range of 10^{-10} -10^{1} Siemens cm^{-1}. PANI is also a unique polymer that exhibits redox activity, electro- and solvatochromic, nonlinear optics, paramagnetism, and other unique properties [1, 2]. In addition, this polymer has no harmful effects on the environment and biological organisms, is resistant to chemicals, has high thermal stability, and has a relatively low cost. Due to all the above properties, PANI was one of the first among the conductive polymers to be used in practice[3]. Today, the development of electronic technology around the world is leading to an increase in the relevance of scientific research in the field of studying the properties of conductive materials, including PANI-based materials. The consistency of

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monomer links of polyaniline contains of reduced (y) and oxidized (y-1) molecules of N-phenylene-p-phenylenediamine[6]. The PANI structure has several different oxidation states, respectively, as follows: leucoemeraldine (y = 1) - a colorless substance, slowly oxidized, another form of emeraldine (y = 0.5) - the substance in this form is blue-purple, Emiraldine salt, formed as a result of its interaction with acid, is dark green; pernigraniline (y = 0) is a purple substance and its salt is light blue [6]. (Fig. 1)

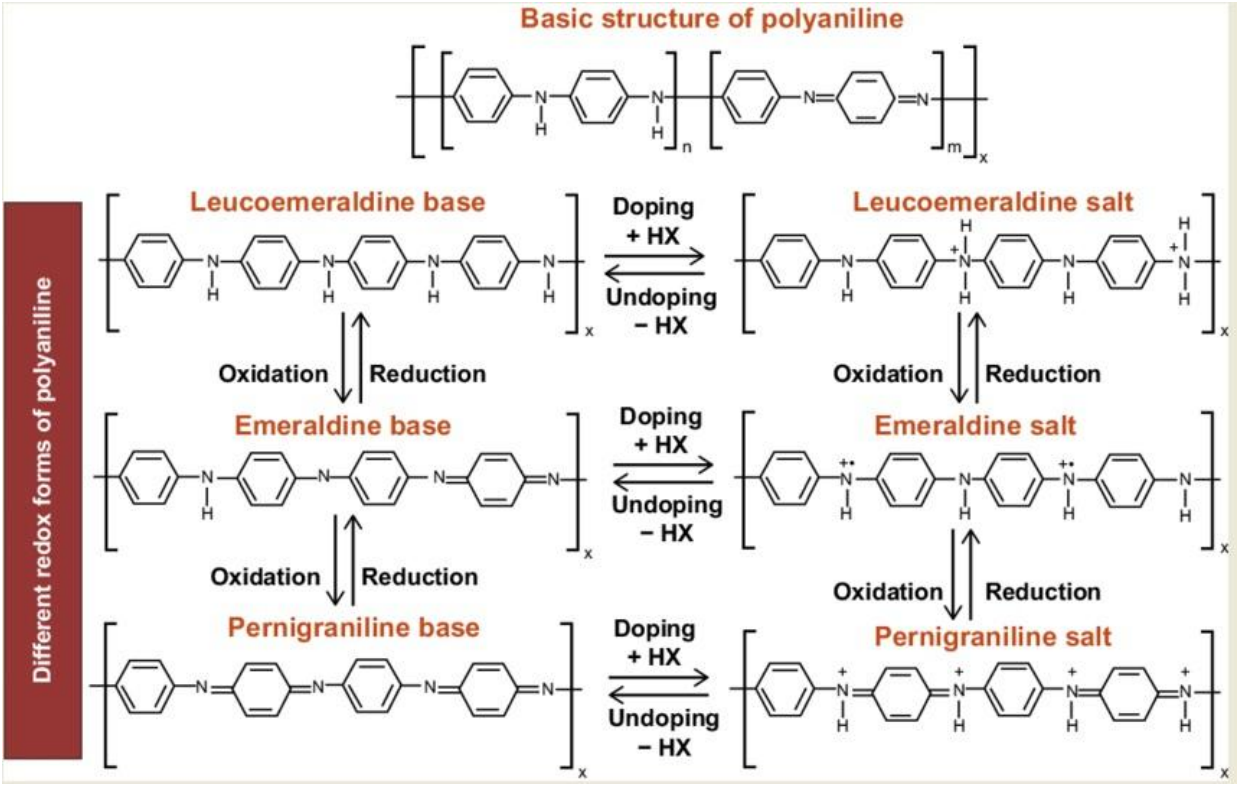

Fig 1. Different redox form of polyaniline.

In the production of PANI are mainly used methods of polymerization of aniline by electrochemical and chemical oxidation.

In this study, the polymerization method of aniline in the presence of oxidants was used for PANI synthesis. The aim was studied to the effect of the oxidizing type, their concentration, solution environment, and other factors on the synthesis of polymer formation, process kinetics in PANI synthesis.

PANI was synthesized by the oxidation method of the hydrogen chloride salt of aniline in an aqueous solution. The polymerization of aniline was carried out at 48° C for 48 h. The resulting PANI forms a precipitate in powder form. The PANI was separated from the solution by

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centrifugation, washed several times with distilled water, and dried until the mass remained unchanged. The reaction equation of PANI synthesis is given below (Figure 2).

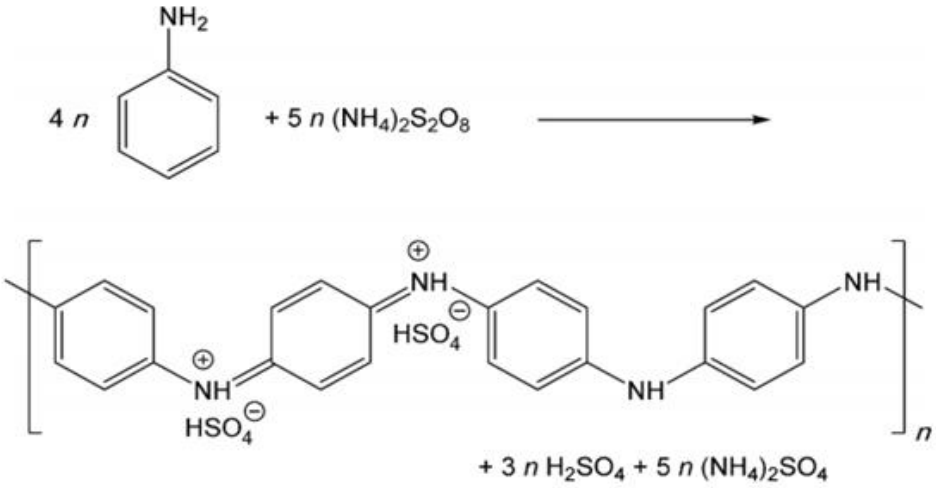

Figure 2. The reaction scheme of PANI synthesis.

The structure of the synthesized PANI was identified by analysis of IR spectra(Figure 3).

To determine the structural changes of PANI the absorption lines of the samples were taken on an FTIR spectrometer**.** The spectral region was adjusted to (400 to 4000) cm^{-1}.

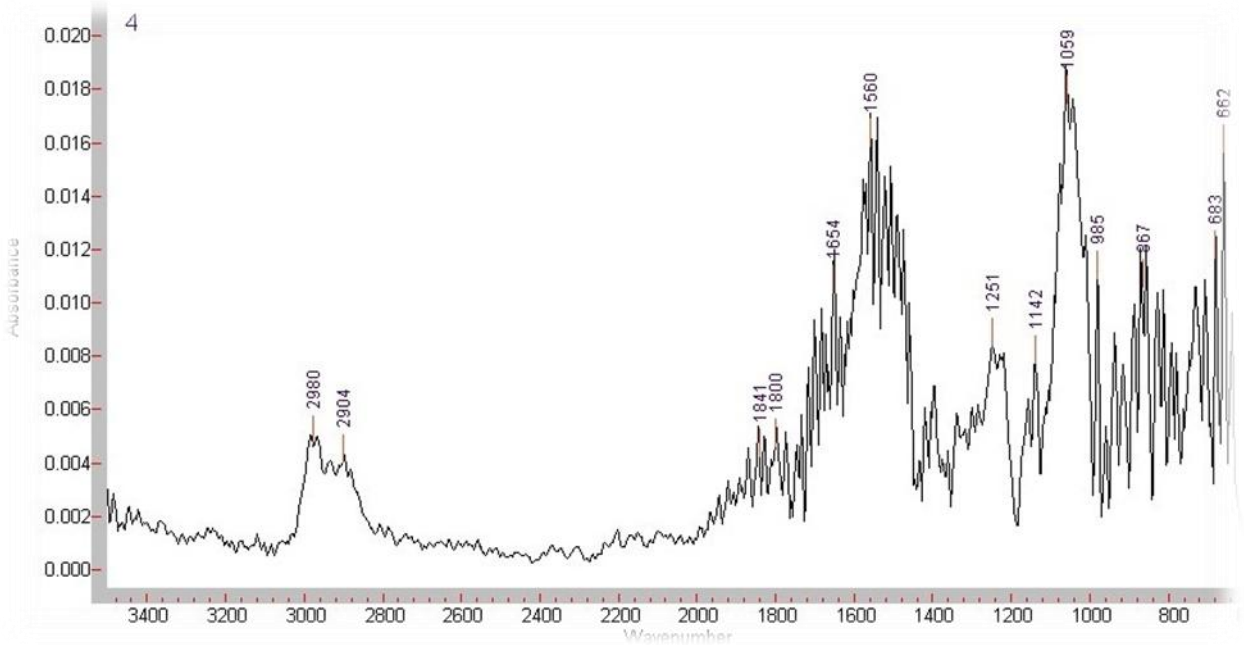

Figure 3. FTIR spectrum PANI-HCl

Functional groups containing nitrogen in the absorption lines in the 3400-2800 cm^{-1} range show, for example, stretching specific to the chemical bonds to the secondary amine –NH– protonated imin $–NH^{+}=$ and the C-H bond in the aromatic ring. Spectral results show

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that the amine and imine groups form polyaniline bonds and that these groups are bonded to each other using hydrogen bonds[4]. 2000 cm^{-1} is a wide absorption range characteristic of the conductive form of polyaniline [1,6].

The C ~ $N^{+\bullet}$ present in the long stretching vibration in the polaron structure of the polymer in the 1245 cm^{-1} field occurs due to the bond (~ double bond or simple bond). 1147cm^{-1} shows -NH^{+}= specific stretching vibration from the most important groups formed as a result of protonation in PANI. The absorption of the 700–900 cm^{-1} H spectrum is specific to the C-H in the ring, which indicates the

bending vibrations of the para-C-H group, while the 808 cm-1 shows that deformation vibrations outside the ring.

CONCLUSION

In the study, PANI was synthesized by oxidative polymerization in the presence of a strong oxidizing agent ammonium persulfate. The synthesized PANI structure was realized by analyzing its IR spectra.

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