

Application of Sensor Effect on Chlorodiazepam of Polyaniline Doped Silver Nanocomposite

C. Usha Rani¹, D. Balakrishnan², C. Pragathiswaran^{3,*}, K. Selvarani⁴

Abstract

In order to ease the creation of the polymeric nanocomposite known as PANI/Ag, pani-doped silver nanoparticles were oxidised chemically and then exposed to the oxidation process. Aniline with varying amounts of silver nanoparticles added to it can be used to make a nanocomposite known as PANI/Ag in an acid solution at room temperature by employing ammonium persulfate as the oxidising agent. This can be done by using aniline with different weight percentages of silver nanoparticles (APS). The structural characteristics of nanocomposites were investigated employing the methods of X-ray diffraction (XRD), ultraviolet-visible (UV-Vis) spectroscopy (UV-Vis), scanning electron microscopy (SEM), and dynamic light scattering (DLS) (DLS). After that, investigative techniques were used to ensure that the products were completely satisfactory and that the sensitising effect of the drug molecule chlorodiazepam was effectively detected in the newly synthesised PANI-doped silver nanocomposite. This was accomplished by ensuring that the products passed all of the tests. This was done in order to satisfy the needs of the research study that was being carried out.

Keywords: XRD, Ag Nanoparticles, Chlorodiazepam, Polyaniline, DLS

INTRODUCTION:

Polyaniline (PANI) polymer matrix has been found to offer a number of benefits including lowcost packaging, corrosion resistance and non-toxicity. However, PANI-based sensors have a number of inherent drawbacks, including reduced specific and stable nature. To rise above these shortcomings Polyaniline is often activated or combined with nanomaterial. Polyaniline (PANI) has been found to offer several benefits [1–4]. However, PANI-based sensors have some inherent drawbacks, such as poor reproduction [5]. It is often activated or combined with nanoparticles (metal/bimetallic/metal oxide). The stability of PANI or nanoparticles (NPs) (metal/bimetallic/metal oxide NPs) with high efficiency of technique such as oxidation to solve these defects in the polyaniline. For chlorodiazepam

measurement, a nano-structured PAN topped silver nanocomposite modified glass carbon electrode (PANI/Ag/GCE) were used. The current proposed electrochemical sensor has the inherent potential to quickly detect chlorodiazepam drugs. For chlorodiazepam measurement, a nano-structured PAN topped silver oxide nanocomposite modified glass carbon electrode (PANI/Ag/GCE) were used. The built-in sensor has the highest detection range sensitivity [6–9]. The current proposed electrochemical sensor has the inherent potential to quickly detect chlorodiazepam drugs. However, as outlying as we know, no research has been published on the voltametric measurement of diazepam in SPCE for its stability in beverages. Diazepam and similar 1,4-benzodiazepines [10–14] Vitreous carbon [15–16], graphite [17],

*Author for Correspondence

Pragathiswaran
E-mail: pragathis46@gmail.com

^{1,2}Research Scholar, Department of Chemistry, Periyar EVR College, (Affiliated to Bharathidasan University, Tiruchirappalli, India

^{3,4}Assistant Professor, Department of Chemistry, Thanthai Periyar Government Arts and Science College (Autonomous), Affiliated to Bharathidasan University, Tiruchirappalli, Tamil Nadu, India

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reduced graphene [18], poly (3,4-ethylenedioxythiophene) (PEDOT) electrochemistry with previous Hg electrodes Studies [19, 20]. The various compounds [21, 22] including PEDOT, graphene, cytosine and metal nanoparticles are the most common voltammetric sensors used to establish caffeic acid. Primary voltametric sensors are used to detect chlorodiazepam, as well as sensing materials, detection mechanism and analytical performance. PANI, on the other hand, has poor mechanical properties, melting point and solubility. Or the biology of AgNPs has been successfully described. The demand for AgNPs has expanded as a result of their various applications in the fields of biomedicine, pharmacy; agriculture and food [23–25]. Derived from plants have been used successfully as antibacterial, antifungal, antiviral and anti-inflammatory drugs [26–28].

METHODOLOGY

Materials

HCL (Merck) 37%, Aniline (Sigma-Aldrich), Ethanol (Merck, 99.8%), 30 percent H_2O_2 , percent, & H_2SO_4 (Merck, 98 percent) Trace metals, Ammonium iron (II) sulfate, 70 percent HCl (Aldrich), 99.99 percent trace metals and distilled water and 97% AgNO_3 . The FTIR spectrum of Polyaniline and its nanomaterial was obtained in the $400\text{--}4000\text{ cm}^{-1}$ range. The UV-visible absorption spectrum of PANI and its nanocomposites was obtained on the Shimadzu FTIR-8400 spectrometer (Tokyo, Japan). Data were collected at NMP in the range of $250\text{--}800\text{ nm}$ using the Hitachi U-2900 spectrophotometer (Tokyo, Japan). Materials were incorporated to XRD. (Figure 1)

Preparation of Polyaniline

To make a polyaniline substance, oxidant polymerization was utilised. 9 ml aniline (1 M) was mixed with 3 ml hydrochloric acid (1 M) and agitated for 15 minutes to produce aniline hydrochloride. An oxidant, 0.1 M Ammonium Per Sulphate (APS), should be gently added to this solution and completely polymerized at 50°C for 4 hours with steady stirring [29]. To achieve a stable mass, the precipitate was filtered with deionized water, rinsed with acetone, and then dried in an oven for 24 hours.

Polyaniline Doped Silver oxide (PANI/Ag) Nanomaterials

Polyaniline doped silver (PANI/Ag) nanocomposite were prepared in one place using a chemical antioxidant polymerization process. Aniline hydrochloride was prepared by mixing 1 M of 9 ml aniline with 1 M of 3 ml HCl acid and stirring for 10 min. Ag substance was mixed in the mentioned solution with a constant stirring so that it is uniformly suspended in the solution [30]. To fully

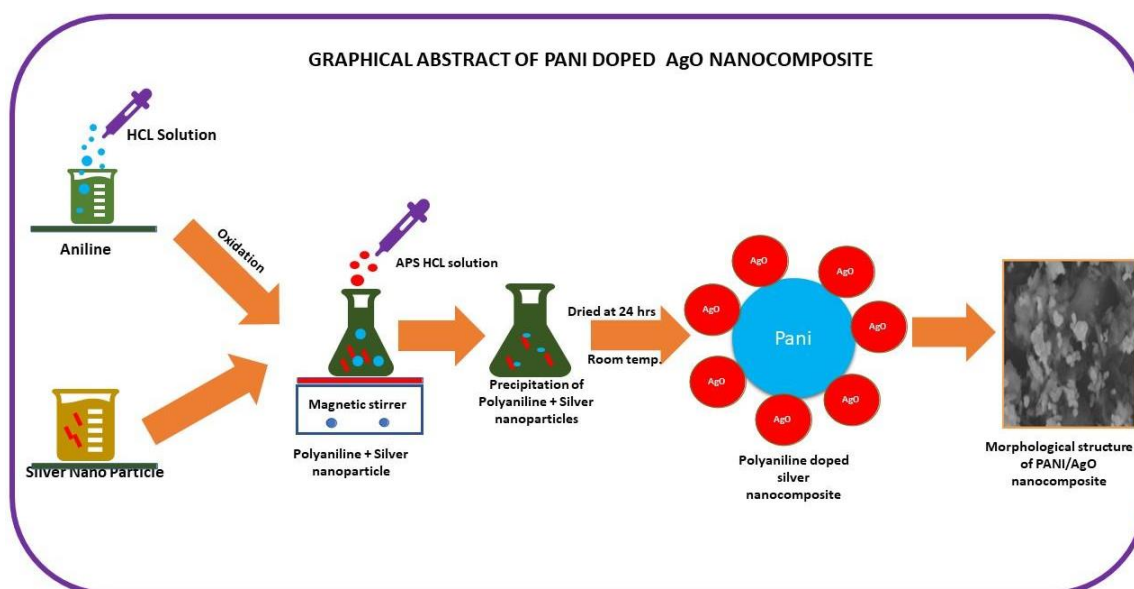


Figure 1. Graphical abstract of PANI/silver Nano composite.

polymerize, 0.1M Ammonium Persulfate (APS), an oxidant, was mixed slowly to the solution constantly at 60°C for 4 h. To achieve a stable mass, the precipitate was filtered, rinsed with deionized water and acetone, and then dried in an oven for 24 hours. This method was used to form polyaniline/silver nano composites with different Ag weight percentages (5, 10, 15, 20 and 25%).

RESULTS AND DISCUSSION

Fourier-transforms Infrared Spectra

The FT-IR spectra of PANI and PANI/Ag nanocomposites were analysed. The primary polyaniline line characteristic was found in connected to the peaks seen in Figure 2. The wavenumbers at 1581 and 1496 cm^{-1} , respectively, represent the quinoid and benzenoid structures of the PANI. The band at 1246 cm^{-1} is responsible for the C–N elongation of the aromatic amine. The peaks at 1149 and 834 cm^{-1} respectively, correspond to the asymmetric and symmetric C = O extension and indicate the presence of PANI/Ag on the premises [31]. As a modified metal, silver has a high likelihood of forming fusion compounds with nitrogen atoms in the PANI macromolecule. Coupling strengths of C = N, C = C and CN for FT-IR spectroscopy methods are shown in the Figure 2. [32–39]

UV-Visible Spectrum of Polyaniline with Silver Nanocomposite

Figure 3 depicts the UV-Visible of PANI and PANI/Ag nanocomposite. The prepared nanocomposite absorbs ultraviolet and visible light well. At 200 nm, three peaks are observable. 329 nm and a broad peak in the 580–750 nm range. PANI/Ag nanocomposite (25%) absorption of peak range in around 199 nm could be assigned to the characteristic absorption of silver metallic nano composite its cluster form [7].

X-ray Diffraction Investigation (XRD)

An XRD was investigated for the structure of pure polyaniline and (PANI/Ag) nano composite. Nano composite at 25 percent increase in concentration silver nano composite with a uniformly distributed polymer matrix (Figure 4). The PANI and (PANI/Ag) corresponded to cubic structure of silver and found at 29 (114), 32 (221), 46 (112) and 58 (002) [Riede et al. 1997] with JPCD no 89–7855. The X-ray diffraction analysis of polyaniline doped silver in the nano composite using the Debye–Scherer formula with particle size was confirmed to be 1.641 nm.

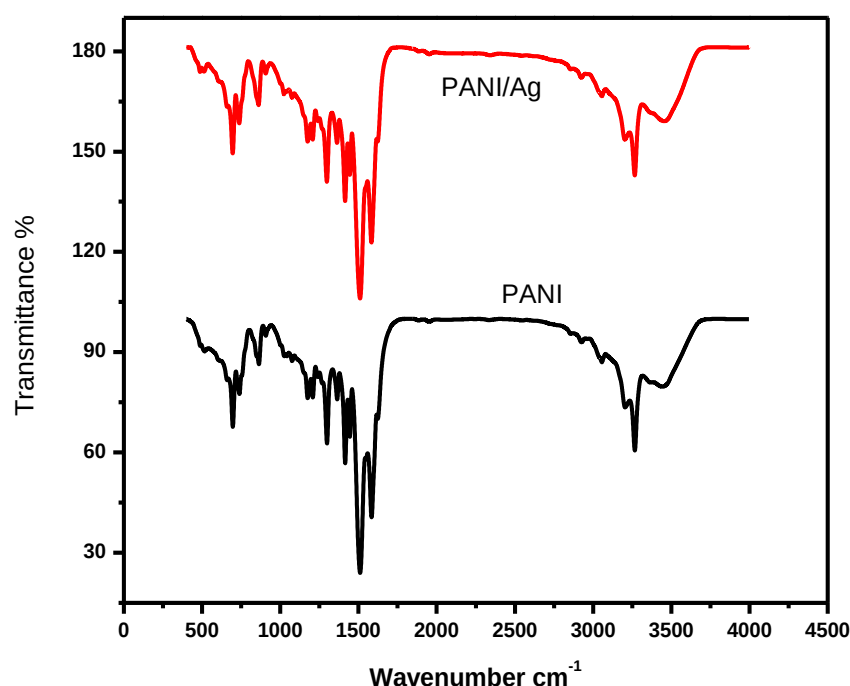


Figure 2. FT-IR Spectrum of Polyaniline doped Ag nanocomposite.

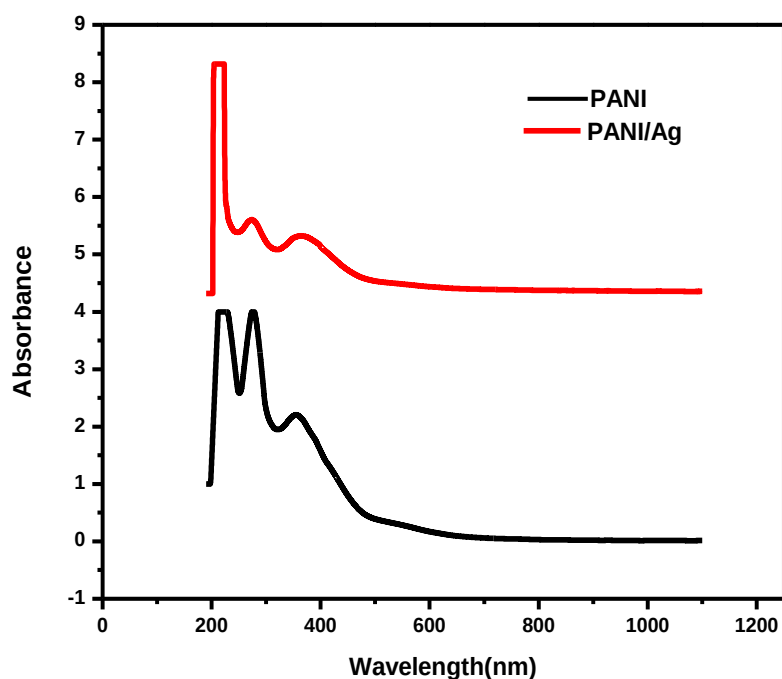


Figure 3. UV-Visible of spectrum of Pani/Silver nanocomposite.

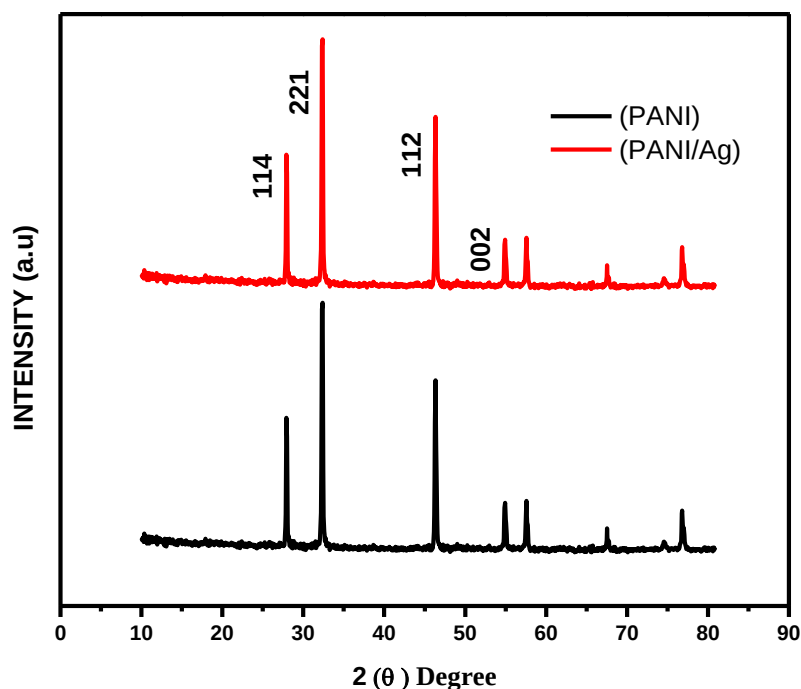


Figure 4. XRD image of Pani/Silver Nano composite.

DLS STUDIES OF PANI DOPED SILVER NANOCOMPOSITE

DLS techniques The strong absorption of light by the PANI/Ag nano composite reaction mixture prevents a direct observation of light scattering during polymerization (Figure 5). The dilution mixture was immediately characterised by particales size using dynamic light scattering (DLS) experiments after 10 ml was diluted with 10 ml of 1 M HCL in 60s interval. The diameter and length of PANI/Ag nanocomposite are attributed to two peaks at 2.7 nm and 261.6 nm in the size distribution of nano composite particles [29, 30]. Furthermore, the DLS findings were compared to SEM morphological studies.

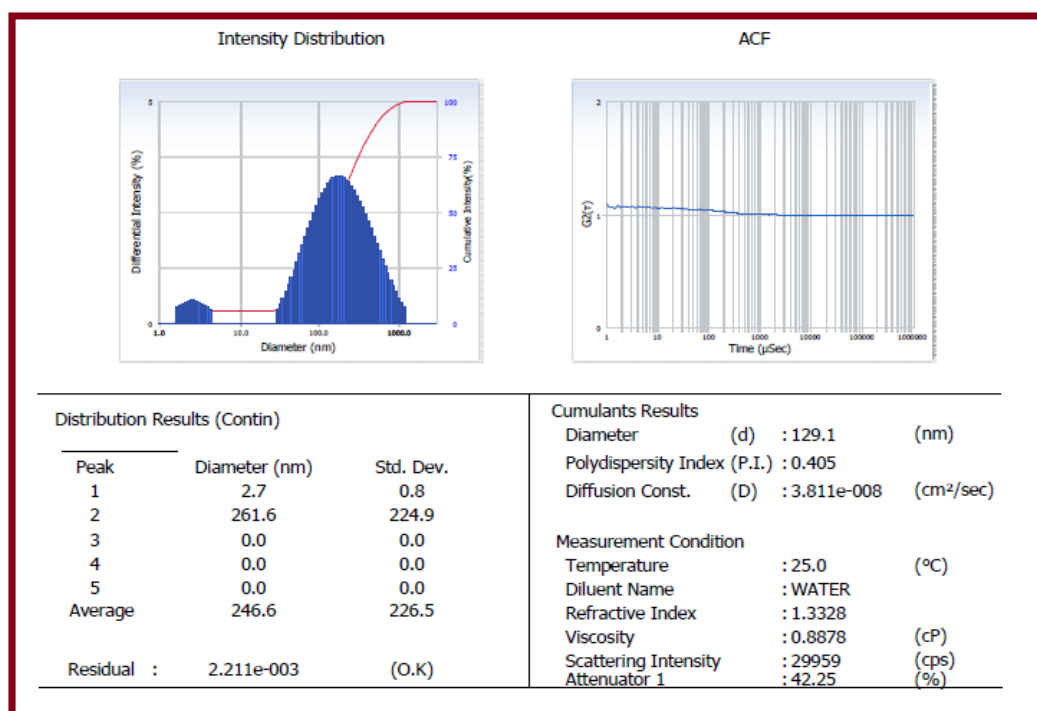


Figure 5. DLS size distribution Curve of Polyaniline doped Silver nanocomposite.

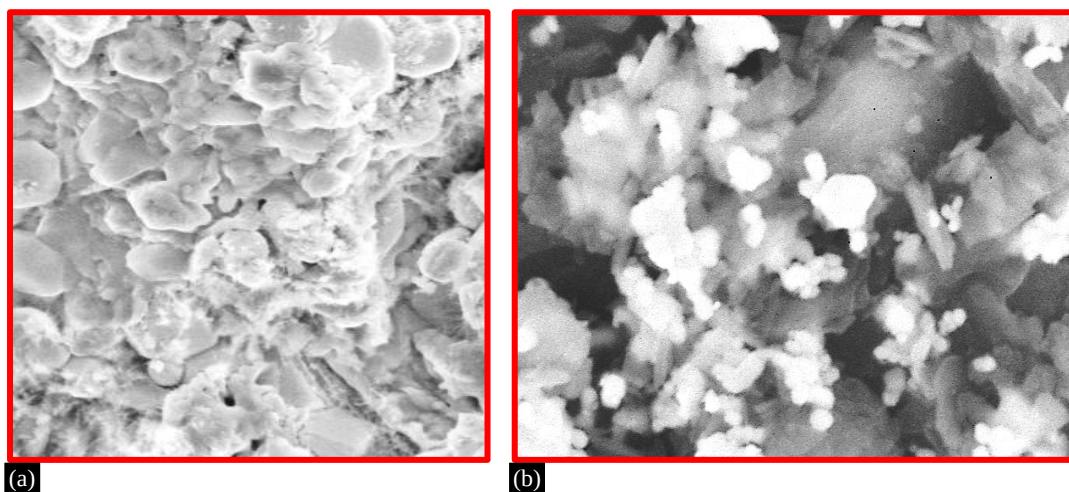


Figure 6. SEM Image of (a) PANI and (b) PANI-doped Ag nanocomposite.

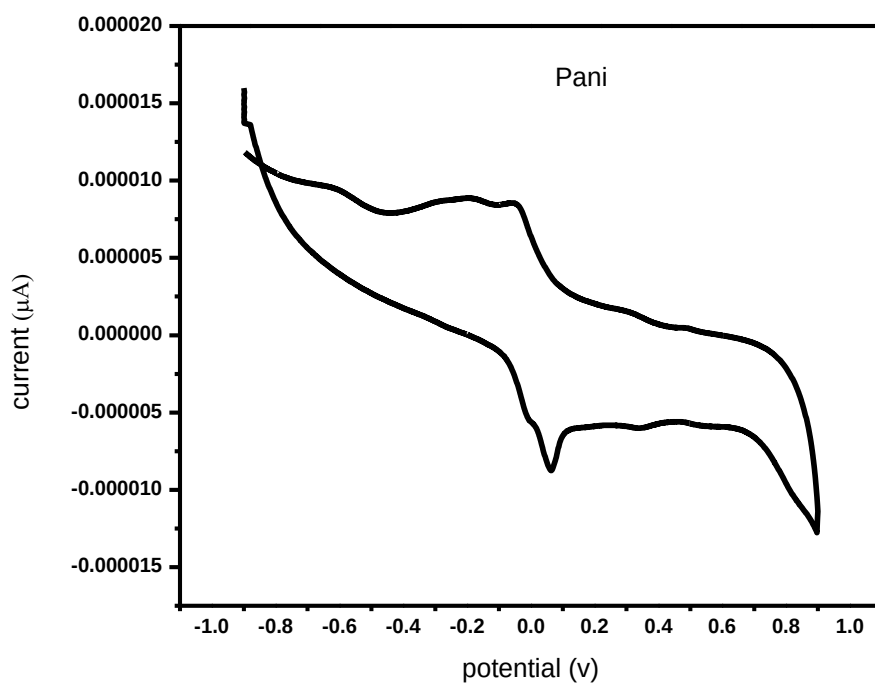
Scanning Electron Microscope (SEM)

SEM image of Polyaniline and PANI doped silver nanocomposite. The SEM image (Figure 6) of Polyaniline, cluster spherical shaped particles, clearly appeared in the microscope [37]. The second image of Polyaniline/silver nanocomposite shows that the Pani/Ag nanocomposite has a cluster structure. Because of the strong metal bonding due to silver metal metal doped Pani. The morphology of silver particles widely speared on polyaniline into pani/Ag great intercalated PANI nanoparticles is medium globular (rice grain), as previously reported [21].

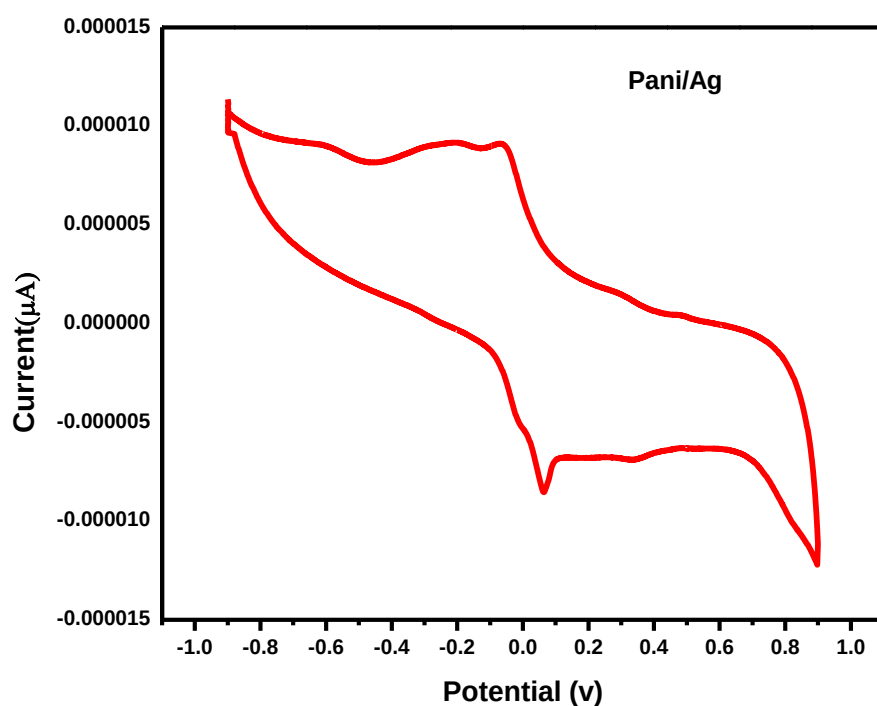
Cyclic Voltammetry

The electronic properties of the current maintain are important for an electrochemically sensitive object. Enhanced current response and small difference in peak energy are key characteristics of professional electron mediators (DEp). The sensor responds to various components of Pani/Ag/GCE,

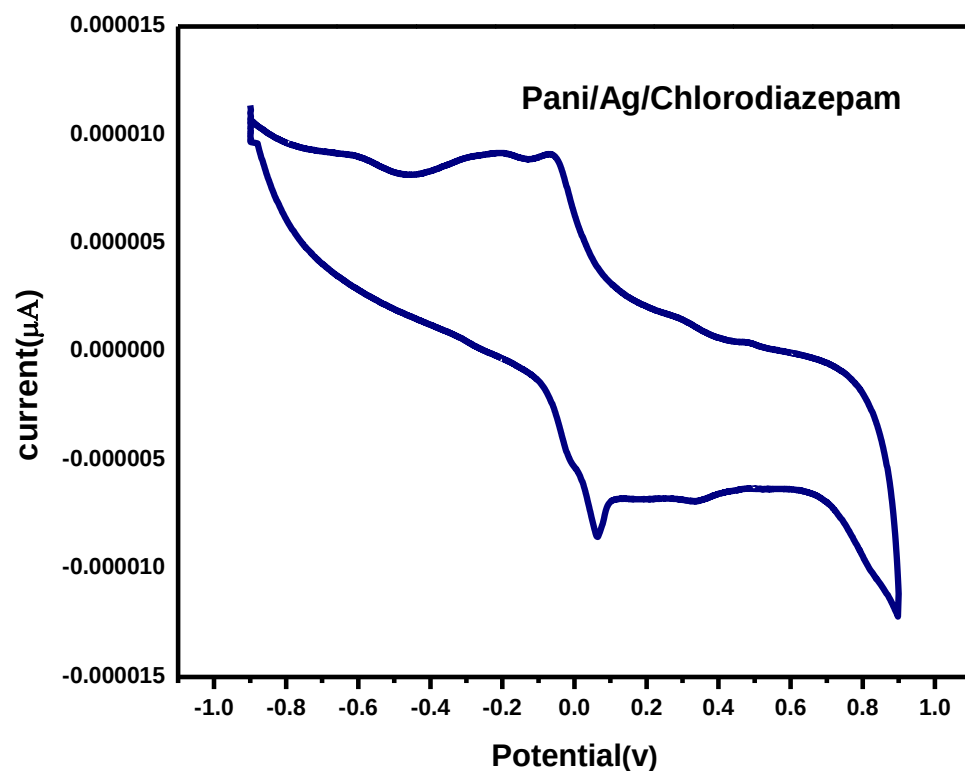
Chloro diazepam) [31] (pH-7). In this study, a simple and effective sensor set was created by immersing Pani doped Ag nanocomposite in Choloro diazepam solution in glass cuvettes and measuring the response of PANI/Ag nanocomposite against Choloro diazepam measurement (Figure 7a–7d). After immersion in diazepam solutions, the immersion period for Pani/Ag to diazepam can be easily determined using a cyclic voltameter and conventional signal values. The PANI/silver nanocomposite showed an initial rise after being exposed to 100 ppm diazepam for a period of time [32] (Figure 8).



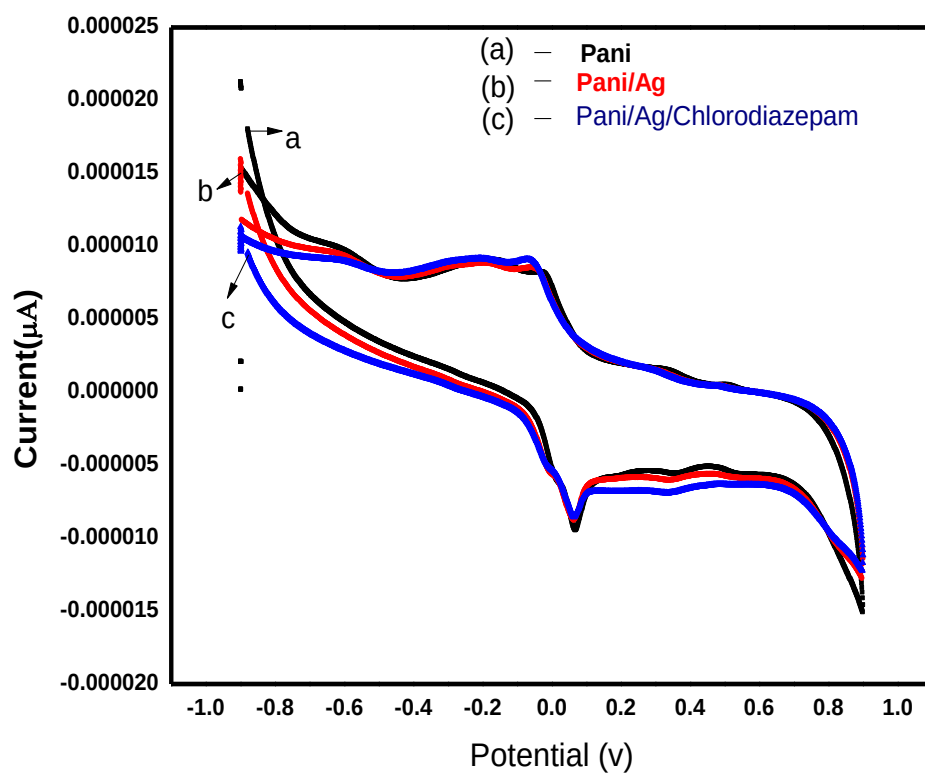
(a)



(b)



(c)



(d)

Figure 7. (a) Cyclicvoltammogram of the GCE/PANI, (b) Cyclicvoltammogram of the GCE/PANI/Ag, (c) Cyclicvoltammogram of the GCE/PANI/Ag/CHLORODIAZEPAM, (d) Cyclicvoltammogram of the GCE/PANI/PANI/Ag/CHLORODIAZEPAM.

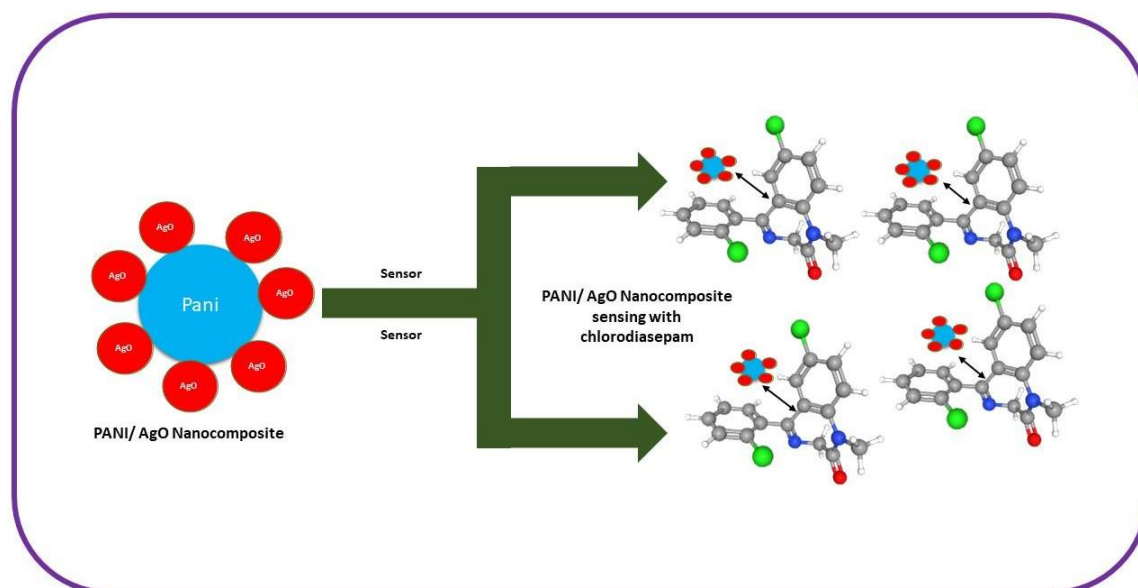


Figure 8. Graphical Abstract of Pani/Ag Sensor Effect of Chlorodiazepam.

CONCLUSION

PANI could effectively encapsulate PANI and Ag nanocomposite using in-situ chemical oxidation processes. PANI on the surface of Ag nanoparticles leads to the production of PANI/nanocomposite when the FTIR, UV, XRD, and SEM detection methods are used. The findings indicate that adding metal oxide to PANI and Ag nanoparticles leads to an increase in polymerization and a more accurate sensing of chlorodiazepam against PANI/Ag. When compared to unadulterated PANI, the nanocomposite interaction between diazepam drug molecules demonstrates a higher degree of sensitivity during testing with a cyclic voltmeter. Effective characteristics of sensitivity shown by PANI-doped silver nanocomposite.

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