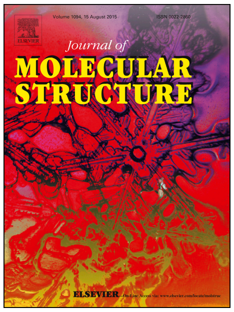

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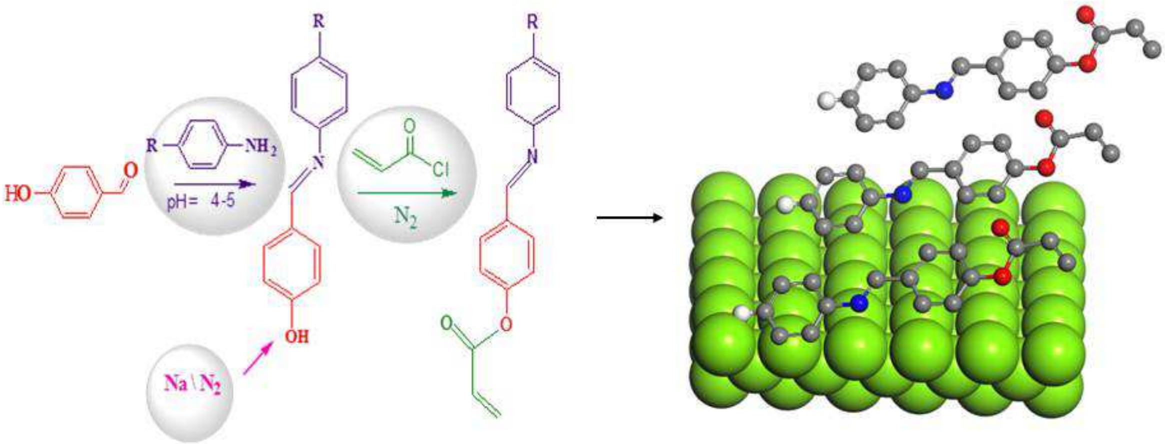
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Synthesis of Novel Schiff Bases Containing Acryloyl Moiety and the Investigation of Spectroscopic and Electrochemical Properties

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ABSTRACT

A novel Schiff bases and their acryloyl derivatives were synthesized through the reaction of *p*-hydroxybenzaldehyde in order of with aniline, *p*-chloroaniline, *p*-nitroaniline, *p*-metilaniline and *p*-aminobenzoic acid. The structures of these compounds were characterised spectroscopic techniques such of IR, ^{1}H-NMR, ^{13}C-NMR and Mass spectroscopy. π→π* and n→π* transitions were determined via UV-Vis spectroscopy studies performed in EtOH, $CHCl_3$, and DMF. Furthermore, the inhibition efficiencies of these new compounds were investigated on the surface of steel within the solution of 0.1M NaCl, 0.1 M NaOH and 0,10 M H_2SO_4 solution via cyclic voltammetry and Tafel extrapolation methods.

Keywords: Schiff bases; acryloyl chloride; Tafel polarisation analysis; corrosion inhibition

Highlights

Novel Schiff bases containing acryloyl moiety were synthesised.

Structural characterizations were performed via IR, UV-Vis, and NMR spectroscopy.

The inhibition efficiencies of these novel Schiff bases were investigated by cyclic voltammetry and Tafel extrapolation methods.

These compounds may have a pioneer significance role in synthesizing novel organic materials.

1. Introduction

Schiff bases are versatile molecules and have received much attention in many types of research [1-2]. They are widely used in various fields, particularly as corrosion inhibitors, dyes and pigments, and catalysts for activation of small molecules and also they have a fairly large biological activities [2-6]. Structurally, a Schiff base (also known as imine or azomethine) is a nitrogen analogue of an aldehyde or ketone in which the carbonyl group (C=O) has been replaced by an imine or azomethine group [3]. Due to the presence of the –C=N- group, an electron cloud on the aromatic ring, the electronegative nitrogen, and the oxygen and sulphur atoms in the molecule, Schiff bases are considered as good corrosion inhibitors [7]. Inhibitors are used to prevent metal dissolution and thus minimise the acid consumption. Schiff bases are shown to have excellent corrosion inhibition efficiencies as compared to those of the individual constituents [8-9]. Also, they are easily obtained from cost-effective starting materials and harmless to the environment [10]. Despite a large number of organic compounds, there is always a need for the development of new organic corrosion inhibitors [7]. Generally, Schiff bases come into effect on a metal surface with adsorption [11-12]. The corrosion inhibition efficiency depends on the electron density and polarizability of the functional groups [13]. Both protonated and non-protonated functional groups form intermediate bridges with the metal surface blocking the interactions between the metal surface and corrosive ingredients [14]. The mechanism of corrosion inhibition on metals can be clarified primarily using theoretical modelling and simulations. The highest occupied molecular orbital (HOMO) and lowest unoccupied molecular orbital (LUMO) calculations indicate the mechanism of corrosion inhibition as well as the interactions with the metal surface [15].

In this study, we have reported the synthesis of novel Schiff bases with imine (>C=N) and acryloyl groups. The compounds have been synthesised in two stages. In the first stage, Schiff bases were obtained by the reaction between various aniline derivatives with *p*-hydroxy benzaldehyde at pH 5. In the second stage, the acryloyl derivatives of Schiff bases have been obtained by the reaction of metallic sodium and acryloyl chloride under inert atmosphere according to the Schotten-Baumann method.

The structural characterizations were performed by spectroscopic methods (IR, UV-Vıs, ^{1}H-NMR, ^{13}C-NMR, and Mass). UV-VIS spectroscopy analyses were performed in a variety of solvents with different polarity and pH values. Moreover, their inhibition efficiencies were determined in basic and acidic media by cyclic voltammetry and Tafel extrapolation methods. Synthesis of novel Schiff bases containing acryloyl moiety has never been reported so far to the best of our knowledge.

2. Experimental

The melting points were determined using a digital melting point apparatus. The spectrum was recorded on a Thermo Scientific Class 1 Laser Product FTIR spectrophotometer via ATR. Absorption spectra in ethanol, chloroform, and DMF were determined using a Thermo Scientific Genesys 10S UV-VIS spectrophotometer. Elemental, ^{1}H-NMR, and ^{13}C-NMR analyses were performed in the Instrumental Analysis Laboratory of METU Central Laboratory. All electrochemical measurements were performed in an Ivium Compactstat Potentiostat/Galvanostat device through two scans. The syntheses were carried out in the Organic Chemistry Laboratory, Science and Literature Faculty, Hitit University, and the inhibition activities were determined in the Research Laboratory, Engineering Faculty, Hitit University.

2.1. The synthesis of acryloyl derivatives of Schiff bases.

In the first step, Schiff bases were prepared by the reaction between *p*-hydroxybenzaldehyde and aniline, *p*-chloroaniline, *p*-nitroaniline, *p*-methylaniline, and *p*-aminobenzoic acid separately in dry Toluene at 1:1 molar ratio as described in the literature [2, 16-17]. In the second step, acryloyl derivatives of Schiff bases were synthesised by the reaction of these compounds with metallic sodium, and then acryloyl chloride under N_2 atmosphere at 1:1 molar ratio. The general reaction scheme and the structure of the related compounds were shown in Figure 1.

2.1.1. Synthesis of (*E*)-4-((Phenylimino)methyl)phenol), 1

p-hydroxybenzaldehyde (1.22 g; 0,01 mol) and aniline (0.93 g; 0.91 mL) were dissolved in dry Toluene of 35 mL. Glacial acetic acid was added dropwise to the solution obtained until pH: 4-5 and then refluxed for 24 hours. The by-product (water) was removed by distillation in order to increase the Schiff bases yield. The remaining solution was refluxed again for three hours. The product precipitated by cooling solution to the room temperature. The reaction medium was filtered and dried. The product was purified from ethanol/water to give the present compound of m.p. 124-125 °C. Yield: 84 %. IR (cm^{-1}): 3391-3121 (OH), 1573, 1514 (-C=C-), 1601 (HC=N-), 1283, 1241 (C-O). ^{1}H-NMR (500 MHz, d_6-DMSO, ppm): δ 10.19 (1H, s, ArOH), 8.44 (1H, s, N=CH, (H3), 7.79 (2H, d, $Ar_{benz.}$(H2)), 7.37 (2H, t, $Ar_{Aniline}$ (H5)), 7.21 (3H, d, $Ar_{Aniline}$ (H4, H6)), 6.94 (2H, d, $Ar_{benz.}$(H1)). ^{13}C NMR (500 MHz, d_6-DMSO, ppm): δ 161.2 (C1), 160.4 (C5, -CH=N), 152.5 (C6), 131.2 (C3), 129.9 (C8), 128.0 (C4), 125.8 (C9), 121.3 (C7), 116.2(C2).

2.1.2. Synthesis of (*E*)-4-((Phenylimino)methyl)phenyl) acrylate, 2

4-((Phenylimino)methyl)phenol (**1**) (0.6405 g; 3.25 mmol) and fresh metallic sodium (74.77 mg; 3.25 mmol) in dry THF (30 mL) were mixed amd stirred under N_2 atmosphere for 24 h. Then acryloyl chloride (0.271 mL; 3.25 mmol) was directly added dropwise to the THF solution of sodium salt of Schiff bases under dry nitrogen atmosphere. After 4 hours stirring, the mixture was filtered and the desired product was precipitated out by evaporating the THF. Afterwards, a pale yellow solid was recrystallized from THF-water. Yield: 64%, m.p.: 140-142 ºC, IR (cm^{-1}): 1773 (-C=O), 1629, 1584 (-C=C-), 1600 (-HC=N-), 1292, 1196, 1165 (C-O). ^{1}H-NMR (500 MHz, d_6-DMSO, ppm): δ 8.44 (1H, s, N=CH, (H3)), 7.78 (2H, d, $Ar_{benz.}$(H2)) , 7.38 (2H, d, ArAniline (H5)), 7.20 (2H, d, $Ar_{Aniline}$ (H4)), 7.19 (1H, t, $Ar_{Aniline}$ (H6)), 6.91 (2H, d, $Ar_{benz.}$(H1)), 6.30 (1H, d, (H7)), 5.60 (2H, d, (H8, H9)) (CH_2=CH-). ^{13}C NMR (500 MHz, d_6-DMSO, ppm): δ 165.2 (C11) (>C=O); 160.5 (C5, -CH=N), 152.5 (C1), 149.9 (C6), 132.6 (C13), (CH_2=CH-), 131.1 (C4), 129.7 (C8), 129.6 (C3), 127.8 (C12), 125.8 (C9), 121.3 (C7), 116.2 (C2) Anal. Calcd for $C_{16}H_{13}O_2N$: C, 76.49; H, 5.17; N, 5.57 %. Found: C, 75.87; H, 5,14; N, 5.12 %.

2.1.3. Synthesis of (*E*)-4-((4-Chlorophenylimino)methyl)phenol), 3

The procedure used for the synthesis of compound **1** was also used for the synthesis of compound **3**. Therefore, compound **3** was synthesised by using *p*-hydroxybenzaldehyde (1.22 g; 0.01 mol) and 4-chloroaniline (1.27 g; 0.01 mol) in dry Toluene (35 mL) at pH 4-5 and purified using ethanol/water. m.p.: 184-185 °C. Yield: 82%. IR (cm^{-1}): 3236-3180 (OH), 1586, 1514 (-C=C-), 1598 (HC=N-), 1288, 1250 (C-O), 1109 (C-Cl). ^{1}H-NMR (500 MHz, d_6-DMSO, ppm): δ 10.18 (1H, s, ArOH), 8.45 (1H, s, N=CH, (H3)), 7.76 (2H, d, $Ar_{benz.}$(H2)), 7.43 (2H, d, $Ar_{Aniline}$ (H5)), 7.23 (2H, d, $Ar_{Aniline}$ (H4)), 6.94 (2H, d, $Ar_{benz.}$(H1)). ^{13}C NMR (500 MHz, d-DMSO, ppm): δ 161.3 (C1), 161.2 (C5, -CH=N), 151.2 (C6), 131.3 (C9), 129.9 (C3), 129.5 (C8), 127.7 (C4), 123.2 (C7), 116.4 (C2),

2.1.4. Synthesis of (*E*)-4-((4-Chlorophenylimino)methyl)phenyl) acrylate, 4

The procedure used in the synthesis of compound **2** was also used in the synthesis of compound **4**. Therefore, compound **4** was synthesised using (*E*)-4-((4-Chlorophenylimino) methyl) phenol), (**3**) (1.779 g; 8.26 mmol) and fresh metallic sodium (189.9 mg; 8.26 mmol) in dry THF (40 mL) and acryloyl chloride (0.688 mL; 8.26 mmol) and the yellow product was purified using THF-water. Yield: 79%, m.p: 144-145 ºC, IR (cm^{-1}): 1749 (-C=O), 1662, 1627 (-C=C-), 1597 (-HC=N-) 1337, 1202, 1164 (C-O), 1089 (C-Cl). ^{1}H-NMR (500 MHz, d$_6$-DMSO, ppm): δ 8.66 (1H, s, N=CH, (H3)), 8.01 (2H, d, Ar$_{benz.}$(H2)), 7.48 (2H, d, Ar$_{Aniline}$ (H5)), 7.35 (2H, d, Ar$_{benz.}$(H1)), 7.30 (2H, d, Ar$_{Aniline}$ (H4)), 6.59 (1H, d, (H8)), 6.45 (1H, dd, (H7)), 6.21 (1H, d, (H9)) (CH$_2$=CH-). ^{13}C NMR (500 MHz, d$_6$-DMSO, ppm): δ 164.3 (C11) (>C=O), 160.9 (C5, -CH=N); 153.2 (C1), 150.5 (C6), 134.5 (C4), 134.1 (C13), 130.8 (C9), 130.6 (C8), 129.6 (C3), 127.1 (C12), 123.3 (C7), 122.8 (C2) Anal. Calcd for $C_{16}H_{12}O_2NCl$: C, 67.25; H, 4.20; N, 4.90 %. Found: C, 67.87; H, 4.01; N, 4.38 %.

2.1.5. Synthesis of (*E*)-4-((4-Nitrophenylimino)methyl)phenol), 5

The procedure used in the synthesis of compound **1** was also used in the synthesis of compound **5**. Therefore, compound **5** was synthesised using *p*-hydroxybenzaldehyde (1.22 g; 0.01 mol) and 4-nitroaniline (1.38 g; 0.01 mol) in dry Toluene (35 mL) at pH 4-5 and was purified using ethanol/water. m.p.: 182-183 °C. Yield: 83%. . IR (cm^{-1}): 3356 (OH), 1628 (HC=N-), 1600, 1585 (-C=C-), 1468 (-NO$_2$), 1282, 1181 (C-O). ^{1}H-NMR (500 MHz, d$_6$-DMSO, ppm): δ 10.60 (1H, s, ArOH), 9.77 (1H, s, N=CH, (H3)), 7.93 (2H, d, Ar$_{Aniline}$ (H5)), 7.73 (2H, d, Ar$_{benz.}$(H2)), 6.94 (2H, d, Ar$_{benz.}$(H1)), 6.69 (2H, d, Ar$_{Aniline}$ (H4)), ^{13}C NMR (500 MHz, d-DMSO, ppm): δ 163.8 (C1), 163.2 (C3, -CH=N), 156.1 (C6), 136.2 (C9), 132.5 (C5), 128.9 (C4), 126.8 (C8), 116.3 (C7), 112.8 (C2).

2.1.6. Synthesis of (*E*)-4-((4-Nitrophenylimino)methyl)phenyl) acrylate, 6

The procedure used in the synthesis of compound **2** was also used in the synthesis of compound **6**. Therefore, compound **6** was synthesised using (*E*)-4-((4-nitrophenylimino) methyl) phenol), (**5**) (2.023 g; 8.27 mmol) and fresh metallic sodium (190.3 mg; 8.27 mmol) in dry THF (40 mL) and acryloyl chloride (0.699 mL; 8.27 mmol) and the yellow product purified using THF-water. Yield: 72%, m.p.: 114-115 ºC, IR (cm^{-1}): 1744 (-C=O), 1693,1596 (-C=C-), 1627 (-HC=N-), 1468 (-NO_2), 1295, 1281 (C-O), ^{1}H-NMR (500 MHz, d-DMSO, ppm): δ 8.66 (1H, s, N=CH, (H3)), 8.03 (2H, d, $Ar_{benz.}$(H2)), 7.93 (2H, d, $Ar_{benz.}$(H1)), 7.41 (2H, d d, $Ar_{Aniline}$ (H4)), 7.28 (2H, d, $Ar_{Aniline}$ (H5)), 6.59 (1H, d, (H8)), 6.44 (1H, m, (H7)), 6.20 (1H, d, (H9)) (CH_2=CH-). ^{13}C NMR (500 MHz, d_6-DMSO, ppm): δ 164.3 (C11) (>C=O), 163.3 (C5, -CH=N), 156.2 (C6), 153.7 (C1), 145.4 (C9), 134.7 (C13), 133.6 (C4), 131.6 (C3), 127.9 (C12), 126.9 (C8), 125.4 (C7), 122.4 (C2) Anal. Calcd for $C_{16}H_{12}O_4N_2$: C, 64.86; H, 4.05; N, 9.45 %. Found: C, 63.97; H, 3.93; N, 9.21 %.

2.1.7. Synthesis of (*E*)-4-((4-tolylimino)methyl)phenol), 7

The procedure used in the synthesis of compound **1** was also used in the synthesis of compound **7**. Therefore, compound **7** was synthesised using *p*-hydroxybenzaldehyde (1.22 g; 0.01 mol) and 4-methylaniline (1.07 g; 0.01 mol) in dry Toluene (35 mL) at pH 4-5 and purified using ethanol/water. m.p.: 220-221 °C. Yield %81. IR (cm^{-1}): 3291 (OH), 2919, 2861(-CH_3), 1605, 1574 (-C=C-), 1605 (HC=N-), 1284, 1241,1162 (C-O). ^{1}H-NMR (500 MHz, d_6-DMSO, ppm): δ 10.18 (1H, s, ArOH),)), 8.46 (1H, s, N=CH, (H3), 7.74 (2H, d, $Ar_{benz.}$(H2) , 7.17 (2H, d, $Ar_{Aniline}$ (H4)), 7.12 (2H, d, $Ar_{Aniline}$ (H5)), 6.92 (2H, d, $Ar_{benz.}$(H1)), 2.37 (3H, s, -CH_3 (H6)). ^{13}C NMR (500 MHz, d_6-DMSO, ppm): δ 160.9 (C1), 159.6 (C5, -CH=N), 149.8 (C6), 135.0 (C9), 130.9 (C3), 130.1 (C8), 128.1 (C4), 121.3 (C7), 116.1 (C2), 21.0 (C10), (-CH_3)

2.1.8. Synthesis of (*E*)-4-((4-Tolylimino)methyl)phenyl) acrylate, 8

The procedure used in the synthesis of compound **2** was also used in the synthesis of compound **8**. Therefore, compound **8** was synthesised using (*E*)-4-((4-

Tolylimino)methyl)phenol), (**7**) (1.7282 g; 8.19 mmol), fresh metallic sodium (188.0 mg; 8.19 mmol) in dry THF (40 mL) and acryloyl chloride (0.683 mL; 8.19 mmol) and the dark yellow product was purified using THF-water. Yield: 86%, m.p.: 170-171 ºC, IR (cm^{-1}): 2919, 2850 (-CH$_3$), 1749 (-C=O), 1652, 1506 (-C=C-), 1599 (-HC=N-) 1202, 1164, 1138 (C-O). ^{1}H-NMR (500 MHz, d$_6$-DMSO, ppm): δ 8.64 (1H, s, N=CH, (H3)), 7.98 (2H, d, Ar$_{benz.}$(H2)), 7.34 (2H, d, Ar$_{benz.}$(H1)), 7.21 (2H, d, Ar$_{Aniline}$ (H5)), 7.19 (2H, d, Ar$_{Aniline}$ (H4)), 6.55 (1H, d, (H8)), 6.43 (1H, m, (H7)), 6.19 (1H, d, (H9)) (CH$_2$=CH-), 2.37 (3H, s, -CH$_3$ (H6)). ^{13}C NMR (500 MHz, d-DMSO, ppm): δ 164.4 (C11), 159.1 (C5, -CH=N), 155.2 (C1), 152.8 (C6), 149.1 (C9), 135.9 (C13), 134.4 (C4), 130.3 (C8), 130.2 (C3), 127.9 (C12), 122.7 (C7), 121.5 (C2), 21.1 (C10), (-CH$_3$) Anal. Calcd for $C_{17}H_{15}O_2N$: C, 76.98; H, 5.66; N, 5.28 %. Found: C, 76.25; H, 5.38; N, 5.13 %.

2.1.9. Synthesis of (*E*)-4-(4-hydroxybenzylideneimino) benzoic acid, 9

The procedure used in the synthesis of compound **1** was also used in the synthesis of compound **9**. Therefore, compound **9** was synthesised using *p*-hydroxybenzaldehyde (1.22 g; 0.01 mol) and 4-methylaniline (1.37 g; 0.01 mol) in dry Toluene (35 mL) at pH 4-5 and purified using ethanol/water. m.p.: 254-255 °C. Yield: 94%. IR (cm^{-1}): 3411-2352 (OH), 1679 (-COOH), 1611 (HC=N-), 1587, 1561, 1518 (-C=C-), 1277, 1232, 1160 (C-O). ^{1}H-NMR (500 MHz, d$_6$-DMSO, ppm): δ 12.69 (1H, s, -COOH (H6)), 10.30 (1H, bs, ArOH), 8.43 (1H, s, N=CH, (H3)), 7.96 (2H, d, Ar$_{Aniline}$ (H5)), 7.78 (2H, d, Ar$_{benz.}$(H2)), 7.25 (2H, d, Ar$_{Aniline}$ (H4)), 6.93 (2H, d, Ar$_{benz.}$(H1)). ^{13}C NMR (500 MHz, d$_6$-DMSO, ppm): δ 167.6 (C10), (-COOH), 161.9 (C1), 161.6 (C5, -CH=N), 156.4 (C6), 131.6 (C8), 131.1 (C3), 127.8 (C4), 127.7 (C9), 121.4 (C7), 116.2 (C2).

2.1.10. Synthesis of (*E*)-4-(4-hydroxybenzylideneimino) benzoic acid acrylate, 10

The procedure used in the synthesis of compound **2** was also used in the synthesis of compound **10**. Therefore, compound **10** was synthesised using (*E*)-4-(4-hydroxybenzylidene imino) benzoic acid, (**9**) (2.2273 g; 9.23 mmol), fresh metallic sodium (212.2 mg; 9.23 mmol) in dry THF (40 mL) and acryloyl chloride (0.763 mL; 9.23 mmol) and the dark yellow product was purified using THF-water. Yield: 64%, mp: 227-228 ºC, IR (cm^{-1}): 3339-2547 (-COOH), 1739 (-C=O), 1673, 1600 (-HC=N-), 1543, 1512 (-C=C-), 1266, 1205, 1163 (C-O), 1673 (-COOH). ^{1}H-NMR (500 MHz, d$_6$-DMSO, ppm): δ 12.74 (1H, s, -COOH (H6)), 8.64 (1H, s, N=CH, (H3)), 7.79 (2H, d, Ar$_{benz.}$(H2)), 7.21 (2H, d, Ar$_{Aniline}$ (H5)), 7.19 (2H, d, Ar$_{Aniline}$ (H4)), 6.94 (2H, d, Ar$_{benz.}$(H1)), 6.55 (1H, d, (H8)), 6.43 (1H, m, (H7)), 6.19 (1H, d, (H9)) (CH$_2$=CH-). ^{13}C NMR (500 MHz, d$_6$-DMSO, ppm): δ 168.5 (C10), (-COOH), 166.9 (C11) (>C=O), 163.5 (C5, -CH=N), 143.0 (C6), 142.9 (C1), 132.0 (C13), 131.5 (C4), 130.4 (C3), 130.1 (C8), 128.4 (C9), 127.6 (C12), 118.6 (C7), 118.3 (C2) Anal. Calcd for $C_{17}H_{13}O_4N$: C, 69.15; H, 4.40; N, 4.74 %. Found: C, 68.92; H, 4.33; N, 3.92 %.

2.2. Electrochemical Measurements

The electrochemical measurements were carried out in a three-compartment Pyrex cell with a separate compartment for the reference electrode connected to the main compartment via a Luggin capillary. A saturated calomel electrode (SCE) was used as the reference electrode and a platinum sheet as the counter electrode. The working electrode employed was prepared using ST 304 steel (X5CrNi18-10). The working electrode was in the form of a rod prepared in a cylindrical form and embedded in epoxy resin leaving an open surface area of 0.6 cm^2.

The working electrode was mechanically polished using 1200 grit emery paper, washed with double distilled water, and then placed in the test solution. The electrochemical measurements were conducted after 30 minutes immersion time in an experimental solution that ensure a dependable corrosion potential and a system in equilibrium.

The potentiodynamic experiments were carried out at a scan rate of 2 mV s^{-1} and the cyclic voltammograms were recorded at a scan rate 50 mV s^{-1} in between -1.7 V and -0.5 V potential.

First, the solutions of Schiff bases synthesised in NaOH of 0.10 M with the concentrations of 10, 25, 50 and 100 ppm were prepared. Then all electrochemical measurements were performed at room temperature by using Ivium Compactstat (Eindhoven, Netherlands) potentiostat/galvanostat. The measurements were run in each solution using ST 304 steel (X5CrNi18-10) as a working electrode, a platinum plate as a counter electrode, and a calomel electrode as a reference. Cyclic voltammetry measurements were performed at a 50 mV/s scan rate and 10 mV data capture frequency in the range of -1.7 V /-0.5 V potential values. The linear sweep measurements were performed in the same conditions and Tafel polarisation transformations were calculated. At last, cycles of cyclic voltammograms and Tafel polarisation curves were collected in the same graph for each Schiff base for different concentrations of solutions for better comparison.

3. Results and Discussion

3.1. Spectral Analyses of Compounds

In the FT-IR spectra of the Schiff bases obtained by the reaction of *p*-hydroxybenzaldehyde with aniline derivatives, the carbonyl stretching peak of *p*-hydroxybenzaldehyde at 1663 cm^{-1} have disappeared and new peaks at 1628-1598 cm^{-1} and 1627-1597 cm^{-1} have appeared which are attributed to imine group of Schiff bases and their acryloyl derivatives respectively. The stretching frequencies of the -OH groups of Schiff bases with the compound numbers of **1**, **3**, and **7** were observed at ca. 3391-3121 cm^{-1} due to the strong intramolecular hydrogen bonding [18-20]. The stretching frequencies of the -OH groups of compound **5** were observed as a narrow peak at 3356 cm^{-1} for those with non-intramolecular hydrogen bonding. For compound **9**, the stretching frequencies of the -OH groups were observed at 3414-2352 cm^{-1} as very broad peaks, due to the carboxyl groups which were observed in the same region. The middle and sharp absorptions at about 3180 cm^{-1} in the IR spectra of Schiff bases are attributed to the vibration of the –NH groups [21-22]. The -OH group peak in the acryloyl derivative of Schiff bases (compound **2**, **4**, **6**, and **8**) was not observed as expected, due to the esterification of the hydroxyl group with the acryloyl chloride. For compound **10**, the stretching frequencies of the -OH groups were observed at 3339-2547 cm^{-1} as very broad peaks due to the carboxyl groups. The acryloyl derivatives of Schiff bases, characteristic stretching peak of the carbonyl groups of the acryloyl moiety was observed as a very strong singlet absorption at 1773-1739 cm^{-1} [23-24]. For the Schiff bases and their acryloyl derivatives, the strong band was determined in the 1628-1597 cm^{-1} and was assigned to the stretching of imine groups. This peak was shifted slightly towards the lower frequencies in the acryloyl derivatives [5, 25]. The other stretching bands appeared at 1693-1506 cm^{-1} and 1337-1202 cm^{-1}; 1241-1157 cm^{-1} in the spectrum of the compounds are attributed to ethenyl (CH_2=CH-) and aromatic –C=C-; -C(O)-O- and Ar-O, respectively, as given in Section 2. In the IR spectra of Schiff bases, Ar-O stretching peaks were determined in the same region by means of the –C(O)-O- stretching peak of acryloyl derivatives of Schiff bases. The IR spectrum of the Schiff base **8** containing an acryloyl group was shown in Figure 2 as a typical example.

3.2. UV-Vis Spectral Analysis of the Compounds

The characteristic UV-Vis absorption bands of the compounds **1**-**10** were analysed and investigated in different solvents like absolute ethanol, chloroform, and DMF, depending on their solubility. Moreover, same analyses were also performed in DMF at pH=12 and pH=2. The UV-Vis absorption bands related to the compounds **1**-**10** are given in Table 1. The bands observed in the range of 250 to 300 nm were assigned to the B-bands of benzene which were common in all Schiff bases. The band at 380 nm was assigned to n→π* transitions related to azomethine chromophore (-CH=N) [2, 19]. In UV-Vis spectra of the Schiff bases and their derivatives in EtOH, the absorption maxima at 288-320 nm with a high extinction coefficient is attributed to the π→π*. Furthermore UV-Vis spectra of the Schiff bases and their derivatives in EtOH, the absorption maxima at 332-373 nm with a low extinction coefficient are attributed to the n→π*. In addition, in EtOH all acryloyl derivatives (**2**, **4**, **6**, **8**) except **9**, the bands of π→π* transitions were determined in hypochromic shifts at about 3-32 nm as compared to the related Schiff bases (**1**, **3**, **5** and **7**) due to electron-withdrawing effect of acryloyl groups. In DMF, it was observed that π→π* and n→π* transitions of the Schiff bases and their acryloyl derivatives (**1-10**) show bathochromic shifts as compared to their peaks in chloroform. These bathochromic shifts may be a consequence of the higher polarity of DMF than that of chloroform as reported in the literature [2]. While in DMF at pH=2 the Schiff bases and their acryloyl derivatives appear as having an absorption maxima similar with that of DMF as seen in Table 2. Absorption maxima of all the compounds at pH=12 show bathochromic shifts about 19-189 nm as compared to that in DMF. However, at pH=12, the absorption bands indicates that aqueous sodium hydroxide does not hydrolyse the Schiff bases containing acryloyl groups.

The absorption maxima ($\lambda_{max.}$,) for the compounds **1-10** were observed in ethanol at 288-320 nm and 332-373 nm, in chloroform at 292-304 nm and 308-349 nm, in DMF at 289-321 nm and 321-383 nm, at pH=2 287-292 nm and at 384 nm, and at pH=12 288-317 nm and 336-503 nm. In these results, Schiff bases and their acryloyl derivatives appearing as absorption maxima with a high extinction coefficient are attributed to the π→π* and n→π*. The UV-Vis spectrum of the compound **6** can be seen in Figure 3.

3.3. NMR Spectral Analyses of the Compounds

The ^{1}H-NMR chemical shift values of the Schiff bases and their acryloyl derivatives recorded in d_6-DMSO are given in Table 2. The ^{1}H-NMR spectrum of the Schiff base **8** containing an acryloyl group is shown in Figure 4 as a typical example. It was observed in the ^{1}H-NMR Spectra of Schiff bases (**1**, **3**, **5**, **7**, **9**) that the hydroxyl protons resonated at 10.18-10.60 ppm due to strong intramolecular hydrogen bonds. After esterification reaction, the hydroxyl peak was not detected due to the lack of hydroxyl groups as expected (see Table 2 and Figure 4). A sharp singlet is observed within the 9.77–8.44 ppm region of the spectrum, which corresponds to the azomethine (CH=N) proton. It is remarkable that the downfield chemical shift (compound **5** H3= 9.77 ppm) corresponds to the azomethine proton of the *p*-NO_2 derivative (**5**), having has the highest electron affinity. After esterification of the Schiff bases (**2**, **4**, **8**, **10**) except *p*-NO_2 derivative, protons of imine group shifted downfield due to the electronic attractive effect of the acryloyl group. Thus, it can be concluded that the position of the azomethine proton is strongly affected by the electronegative character of the substituents on the phenyl ring as reported in the literature [26-27]. The peaks at 6.69- 8.28 ppm are attributed to aniline protons, and the peaks at 6.91-8.03 ppm are attributed benzaldehyde protons. For acryloyl derivatives, phenyl groups' protons were shifted to downfield as compared to those of Schiff bases analogues. The resonance peaks of ethenyl hydrogen atoms in acryloyl groups of the compounds **2-10** were identified as three different groups (H7, H8, H9) at 5.60-6.59 ppm in good agreement with the literature [28-30]. The peaks of the H7 in *Z* configuration with respect to the carbonyl group in an acryloyl moiety were observed at 6.30-6.45 ppm as doublets and multiplets. On the other hand, the peaks of the H9 in *E* configuration with respect to the carbonyl group were seen at 5.60-6.21 ppm as doublets. For the H8, the related peaks were resonated at 6.47-6.59 ppm. In addition, the binding of acryloyl groups was confirmed by the displacement and disappearance of the hydroxyl signals.

The ^{13}C-NMR chemical shift values of the compounds **1-10** are summarised in Table 3. The spectrum of compound **8** is given in Figure 5. In the ^{13}C-NMR spectrum of the compound **8**, it is clearly seen that the acryloyl group was successfully attached to the oxygen of the hydroxyl group, the presence of >C=O group signal at 164.40 ppm prove this phenomenon, which is in good agreement with the literature value [23-24]. The peaks appearing at 127.93 ppm and 134.47 ppm in the spectra of the compound **8** are attributed to =CH- and $=CH_2$ fragments of the $CH_2=CH-$ group, respectively, as expected. These values are in accordance with the literature [23-24]. The imine group peak (-CH=N), represented by C5 in Figure 5, was observed at 159.11 ppm. In the aromatic region, the peaks at 155.24, 134.43, 130.17, and 121.46 ppm are attributed to benzaldehyde carbon atoms C1, C4, C3 and C2, respectively. The up field peaks at 152.83, 149.11, 130.30, and 122.71 ppm correspond to the aniline group of the carbon atoms C6, C9, C8, C7, respectively. The peak appearing at 21.05 ppm in the spectrum of the compound **8** is attributed to the $Ar-CH_3$ group. In the ^{13}C-NMR spectra of all acryloyl derivatives, C1 atoms bonded to the acryloyl groups were shifted upfield and C4 atoms were shifted downfield compared to their Schiff bases analogues due to the lack of hydroxyl group. There is no significant difference between aniline carbon atoms peak shifts of Schiff bases and their acryloyl derivatives.

3.4 Mass Spectral Studies

The fragmentation pattern of the acryloyl derivative (**6**) is taken as a general scheme showing the main fragmentation paths involved (Figure 6). The mass spectral pattern of compound **6** shows a molecular ion peak (m/z 296.11) which is in good agreement with the molecular weight of the compound 296.24 g/mol. $[NO_2-C_6H_4-N=CH-C_6H_4(OH_2)^+]$ ion gives the characteristic peak of m/z 242.09 through the loss of CH_2CHCO- fragment. The loss of the $[-O-C_6H_4-CH]^+$ fragment gives the strong peak at m/z 151.03 (25%). The peak observed at m/z 105 results from the elimination of the nitro group from the phenyl group.

The EI-MS of the acryloyl derivative (**8**) shows all the expected prominent peaks in good agreement with previously proposed fragmentation paths for compound **6**. In Figure 7, the molecular ion peak appeared at m/z 265.04 (27%) is the molecular weight of the compound **8,** as 266.16 g/mol. The loss of an acryloyl group (CH_2CHCO^+) gives a strong peak at m/z 211.12 (100%). The loss of CH=N and $–CH_3$ fragments from the Schiff bases is confirmed by the fragment at M-42 (m/z 120.06, 47%). The peak at m/z 91.05 $(C_6H_5\text{-}CH_2)^+$ is attributed to a tropylium cation.

3.5 Polarisation measurements

Figure 8 represents potentiodynamic polarisation curves for a steel rod in a 0.1 M NaOH solution in the absence and presence of various concentrations of compounds. As can be seen, anodic reactions of steel are not inhibited in the presence of the inhibitor molecules. Thus, the addition of these inhibitor molecules does not reduce the mild steel dissolution reaction. Table 4 shows the electrochemical corrosion parameters as the corrosion potential (E_{corr}) and corrosion rate obtained by extrapolation of the Tafel lines. Values of current corrosion density i_{corr} value were increased by the addition of the compound in 0.1 M NaOH. Corrosion potential (E_{corr}) shifted to negative potentials.

3.6. Corrosion Protection Analysis of Acrylates

Acrylates of compounds synthesised were tested for the protection corrosion in 0.10 M NaOH for different concentrations of inhibitors. Selected concentrations were 10, 25, 50 and 100 ppm as compared to inhibitor-free solutions, 0 ppm. Corrosion protection, in the other word, working electrode surface passivation was monitored with the cycle voltammograms (CV) for the inhibitor, and in the same concentration. The first cycles of CV diagrams for each inhibitor, in each concentration, are given in Figure 8. Frequently, reduction curves (bottom left of CV) are not used for the comparison of corrosion protection, because reduction peaks can be the result of the decomposition of an inhibitor. This is why the anodic side of curves was zoomed out for better comparison. It was found that increased concentration of all inhibitors causes current resistance at the same potential. Moreover, at the negative current, much more reduction was observed than that in oxidation reactions; this means that solved inhibitor molecules were started to decompose. Compound 4 shows the difference in terms of peak point’s order in the increased concentration of inhibitors at the same potential.

Linear sweep measurements and related Tafel polarisation transformation diagrams are given in Figure 9. According to the diagrams, anodic lines have different slopes representing different corrosion rates. The anodic and cathodic lines were used to calculate corrosion rate in mm/year according to Tafel transformations from Tafel diagrams.

Model diagram fit model process was also used to calculate the corrosion rate and also for the comparison with Tafel data. Different corrosion rate calculation methods are represented in Figure 10, and other corrosion rates are given in Table 4. Tafel anodic and cathodic lines selected manually while the intersection point in the corrosion potential line for more accurate corrosion rate calculations. On the other hand, a fit model calculates corrosion rate automatically for the model polarisation curve.

It is found that the Tafel and model data corrosion rates and potential calculation results are all in a good correlation with each other. This is why only Tafel data is given in Table 4. It is clear in Table 4 that these compounds do not work as an inhibitor in basic media for compound **10**. The corrosion rates of working electrodes in basic media for 25, 50 and 100 ppm for compound **10** are smaller than the rates in inhibitor-free NaOH solution. The convenient compound is the compound 10 and the concentration was 25 ppm in NaOH solution of 0.1 M for corrosion protection of the working electrode, X5CrNi18-10 steel.

Compound **6** was added at the concentrations of 10, 25, 50 and 100 ppm to the solution of H_2SO_4 (0.10 M) to investigate corrosion inhibition ability of compounds in acidic media. Interestingly, acrylate compounds have the ability to inhibit the corrosion of working electrodes in acidic solutions. According to Figure 9.f, slopes of anodic lines in acidic media increases with the increasing concentration of compound **6**. In other words, compound 6 is able to protect ST 304 steel against corrosion in acidic media but not in basic media. The order of protection, in other words, the corrosion rate is not linear with increasing amount of inhibitor. The deviation could be explained with the interactions between inhibitor molecules and the working electrode. The electrode surface could be blocked against current density only at the optimum concentration of inhibitors. Additionally, a situation in which optimum concentration is low or high could be explored using molecular simulation calculations. In future works, we will investigate the inhibition ability of acrylates in NaCl and H_2SO_4 in solutions with different concentrations. Moreover, the inhibition mechanism of acrylate compounds will be explored.

4. Conclusion

In this study Schiff bases containing the acryloyl moiety have been synthesised through a reaction between Schiff bases and acryloyl chloride at 1:1 molar ratio. The structures of these compounds have been characterised via IR, UV-vis, ^{1}H-NMR, ^{13}C-NMR, and mass spectroscopy techniques. In the IR spectra of the acryloyl derivatives, characteristic stretching peaks of the carbonyl groups of the acryloyl moiety were observed as a very strong singlet absorption band at 1773-1739 cm^{-1}. The stretching frequencies of the -OH groups of Schiff base compounds observed at ca. 3391-3121 cm^{-1} were attributed to hydroxyl groups with hydrogen bonding. After esterification, the hydroxyl peaks were not observed as expected. In UV-vis spectra, absorption maxima with a high extinction coefficient of Schiff bases and their acryloyl derivatives were attributed to the $\pi\rightarrow\pi^*$ and $n\rightarrow\pi^*$, respectively. ^{1}H-NMR spectra of the compounds in DMSO has showed a sharp singlet peak within the 9.77–8.44 ppm region, corresponding to the azomethine (CH=N) proton. The mass spectra of the compound **6** and **8** show a molecular ion peak m/z 296.11 and m/z 265.04, respectively, which are in good agreement with the molecular weight of the compounds. In inhibitory studies, it was found that synthesised Schiff bases containing acryloyl moiety as inhibitors in 0.10 M NaOH do not work for the protection of steel against corrosion, but they have great potential in acidic media. The addition of compound **6** into the solution of H_2SO_4 (10 M) gave resistance ability to a working electrode against corrosion between 10 and 50% as compared to inhibitor-free media.

To best of our knowledge, this report is the first example the use of Schotten-Baumann reaction for the modification of Schiff Bases containing acryloyl moiety. This new Schiff bases containing acryloyl moiety have potential applications in electrochemical technologies especially, electrocatalytic, electrochromic, electro-sensing, and data storage applications. Likewise, the investigation of corrosion efficiencies of these new Schiff bases in acidic media is currently underway.

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CAPTIONS

Table 1.	The UV-VIS data of related compounds
Table 2.	^{1}H-NMR data of the related compounds
Table 3.	^{13}C-NMR data of the related compounds
Table 4.	Corrosion potentials and rates of working electrode in 0.10 M NaOH with each concentration of compounds
Figure 1.	Synthesis of Schiff bases and their acryloyl derivatives
Figure 2.	The IR spectrum for (*E*)-4-((4-Tolylimino)methyl)phenyl) acrylate (**8**)
Figure 3.	The UV-Vis spectrum for Synthesis of (*E*)-4-((4-Nitrophenylimino)-methyl)phenyl) acrylate (**6**), in $CHCl_3$, EtOH, DMF, DMF (pH=1), DMF (pH=12) $1.0x10^{-5}$ M
Figure 4.	^{1}H-NMR spectrum of the (*E*)-4-((4-Tolylimino)methyl)phenyl) acrylate, **8**
Figure 5.	^{13}C-NMR spectrum of the (*E*)-4-((4-Tolylimino)methyl)phenyl) acrylate, **8**
Figure 6	The mass spectrum and fragmentation pattern of (*E*)-4-((4-Nitrophenylimino)-methyl)phenyl) acrylate (**6**)
Figure 7	The mass spectrum and fragmentation pattern of (*E*)-4-((4-Tolylimino)methyl)phenyl) acrylate (**8**)
Figure 8	CV diagrams at 0, 10, 50 and 100 ppm concentration of (a); compound **2**, (b); compound **4**, (c); compound **6**, (d); compound **8** and (e); compound **10**.
Figure 9.	Tafel polarisation curves on 0, 10, 25, 50 and 100 ppm concentrations of (a); compound **2**, (b); compound **4**, (c); compound **6**, (d); compound **8**, (e); compound **10** and (f); compound **6** at H_2SO_4 solution.
Figure 10	Corrosion rate calculation diagrams of 100 ppm compound 2, (a); Tafel

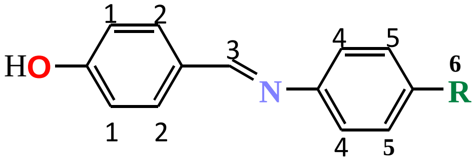
polarisation technique and (b); fit model technique

TABLES

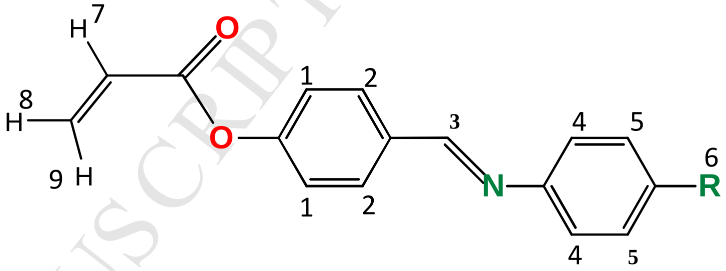
Table 1. The UV-VIS data of related compounds **1-10**

Compounds	Wavelength [λmax (nm)][logε (L/mol.cm)]				
	$CHCl_3$	EtOH	DMF	pH 1-2 (DMF)	pH 12 (DMF)
1	293 (4.38) 311^{o} (4.34)	307 (4.30)	293 (4.25) 328 (3.26) 377 (2.96)	292 (4.32)	302 (3.94) 347 (4.47)
2	297 (4.16) 308^{o} (4.14)	289 (3.46)	294 (4.20) 326° (3.68)	291 (4.29)	311 (4.00) 378 (4.31)
3	297 (4.38)	295^{o} (4.29) 319 (4.34)	301^{o} (4.48) 321 (4.52)	290 (4.40)	306^{o} (4.11) 348 (4.56) 385^{o} (4.11)
4	304 (3.27) 331$^{o(}$3.16)	290 (4.13) 332^{o} (3.58)	314 (3.08)	289 (3.56)	299 (4.11) 336 (3.96) 408^{o} (3.47) 503 (3.56)
5	293 (4.15) 349 (4.44)	291 (4.16) 370 (4.07)	293 (4.41) 383 (4.30)	291 (4.55) 384 (4.26)	309^{o} (4.18) 348 (4.86) 383^{o} (4.27)
6	345 (4.47)	288 (3.95) 373 (4.31)	383 (4.52)	287 (4.25) 384 (4.47)	351 (4.55) 460 (4.05) 489^{o} (3.85)
7	293 (4.45) 322 (4.45)	312 (4.14) 320 (4.40)	293 (4.19) 339 (3.55)	291 (4.28)	303 (3.88) 351 (4.36) 377 (4.22)
8	292 (3.89) 322 (3.87)	288 (3.46)	289 (3.36)	288 (4.00)	288 (4.13) 317^{o} (4.03) 375 (4.14) 452^{o} (3.41)
9	297° (3.63) 326 (3.72)	290 (4.52)	296 (4.57)	291 (4.50)	291 (4.62) 335^{o}(4.13)
10	294 (3.42)	292 (4.38) 297 (4.33)	293 (4.51)	292 (4.57)	290 (4.47) 346 (4.69)

Table 2 ^{1}H-NMR data of the related compounds



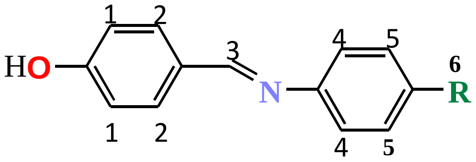
R=H (**1**), CI (3), NO$_2$ (**5**), CH$_3$ (**7**), COOH (**9**)



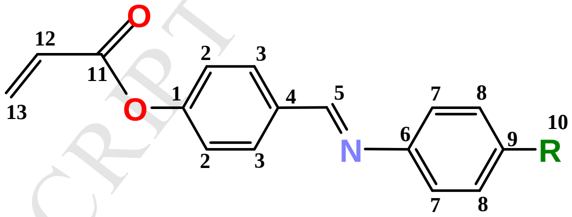
R=H (**2**), CI (4), NO$_2$ (**6**), CH$_3$ (**8**), COOH (**10**)

Compound	**-OH**	**R Group**	**Benzaldeyhe Phenyl Group**		**Aniline Phenyl Group**		**N=CH**	**Acryloyl Group**		
		H6	H2	H1	H5	H4	H3	H7	H8	H9
1	10.19 (s)	8.44 (s)	7.79 (d)	6.94 (d)	7.37 (t)	7.21 (d)	7.21 (d)	-	-	-
2	-	8.44 (s)	7.78 (d)	6.91 (d)	7.38 (d)	7.20 (d)	7.19 (t)	6.30 (d)	6.53 (d)	5.60 (d)
3	10.18 (s)	8.45 (s)	7.76 (d)	6.94 (d)	7.43 (d)	7.23 (d)	-	-	-	-
4	-	8.66 (s)	8.01 (d)	7.35 (d)	7.48 (d)	7.30 (d)	-	6.45 (d,d)	6.59 (d)	6.21 (d)
5	10.60 (s)	9.77 (s)	7.73 (d)	6.94 (d)	7.93 (d)	6.69 (d)	-	-	-	-
6	-	8.66 (s)	8.03 (d)	7.93 (d)	8.28 (d)	7.41(d,d)	-	6.44 (m)	6.59 (d)	6.20 (d)
7	10.18(s)	8.46 (s)	7.74 (d)	6.92 (d)	7.12 (d)	7.17 (d)	2.37(s)	-	-	-
8	-	8.64 (s)	7.98 (d)	7.34 (d)	7.21 (d)	7.19 (d)	2.31 (s)	6.43 (m)	6.55 (d)	6.19 (d)
9	10.30(bs)	8.43 (s)	7.78 (d)	6.93 (d)	7.96 (d)	7.25 (d)	12.69(bs)	-	-	-
10	-	8.44 (s)	7.79 (d)	6.94 (d)	7.90 (d)	7.75 (d)	12.74 (s)	6.32 (d)	6.47 (m)	5.82 (d)

Table 3. ^{13}C-NMR data of the related compounds



R=H (**1**), CI (3), NO_2 (**5**), CH_3 (**7**), COOH (**9**)



R=H (**2**), CI (**4**), NO_2 (**6**), CH_3 (**8**), COOH (**10**)

	>C=0	**-CH=**	**Benzaldehyde Phenyl Group**				**Aniline Phenyl Group**				**Acryloyl Group**		**R**
Compound	**C11**	**C5**	**C1**	**C4**	**C3**	**C2**	**C6**	**C9**	**C8**	**C7**	**C13**	**C12**	**C10**
1	-	160.42	161.15	128.00	131.18	116.15	152.47	125.78	129.96	121.34	-	-	-
2	165.2	160.52	152.46	131.14	129.60	116.18	149.90	125.77	129.69	121.33	132.60	127.77	-
3	-	161.21	161.31	127.74	129.98	116.14	151.22	131.32	129.50	123.16	-	-	-
4	164.34	160.91	153.15	134.48	129.60	122.78	150.54	130.77	130.55	123.34	134.10	127.12	-
5	-	163.22	163.78	128.87	132.53	112.83	156.11	136.16	126.83	116.28	-	-	-
6	164.34	163.26	153.65	133.64	131.64	122.38	156.15	145.42	126.85	125.44	134.56	127.87	-
7	-	159.57	160.93	128.08	130.99	116.07	149.79	135.03	130.09	121.26	-	-	21.02
8	164.40	159.11	155.24	134.43	130.17	121.46	152.83	135.94	130.30	122.71	135.91	127.93	21.05
9	-	161.56	161.86	127.81	131.09	116.21	156.42	127.65	131.55	121.36	-	-	167.61
10	166.90	163.48	142.90	131.51	130.38	118.32	143.00	128.36	130.09	118.61	132.03	127.60	168.48

Table 4. Corrosion potentials and rates of working electrode in 0.10 M NaOH with each concentration of compounds

Compound	**2**	**2**	**2**	**2**	**4**	**4**	**4**	**4**
Concentration	10	25	50	100	10	25	50	100
$E_{corr.}$ (V)	-1,17	-1,075	-1,143	-1,205	-1,152	-1,13	-1,099	-1,14
Corr. R (mm/y)	**0,425**	**0,165**	**0,186**	**0,26**	**0,538**	**0,159**	**0,104**	**0,148**
Compound	6	6	6	6	8	8	8	8
Concentration	10	25	50	100	10	25	50	100
$E_{corr.}$ (V)	-1,12	-1,122	-1,056	-1,184	-1,049	-1,09	-1,082	-1,17
Corr. R (mm/y)	**0,194**	**0,195**	**0,129**	**0,194**	**0,146**	**0,167**	**0,097**	**0,143**
Compound	10	10	10	10	**-**			
Concentration	10	25	50	100	0			
$E_{corr.}$ (V)	-1,19	-1,182	-1,138	-1,223	-11,25			
Corr. R (mm/y)	**0,187**	**0,012**	**0,028**	**0,019**	**0,123**			

FIGURES

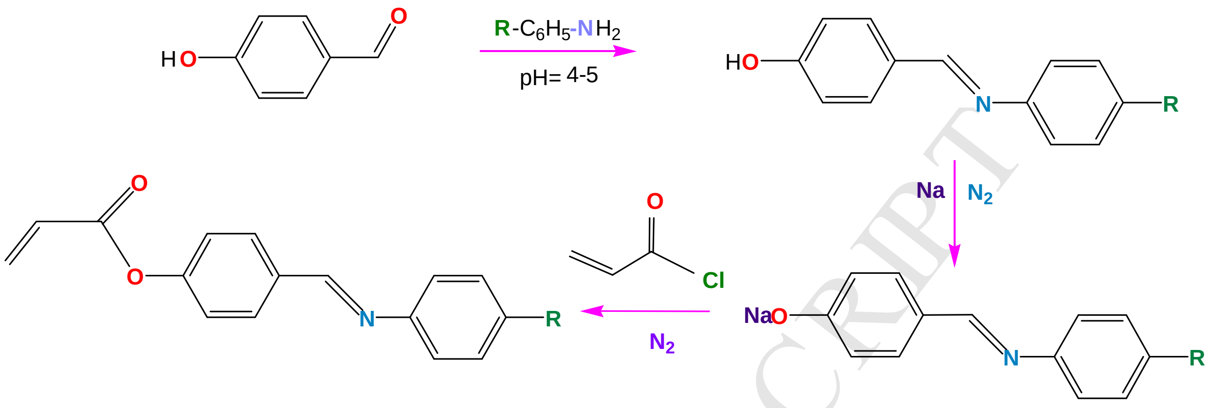


Figure 1. Synthesis of Schiff bases and their acryloyl derivatives

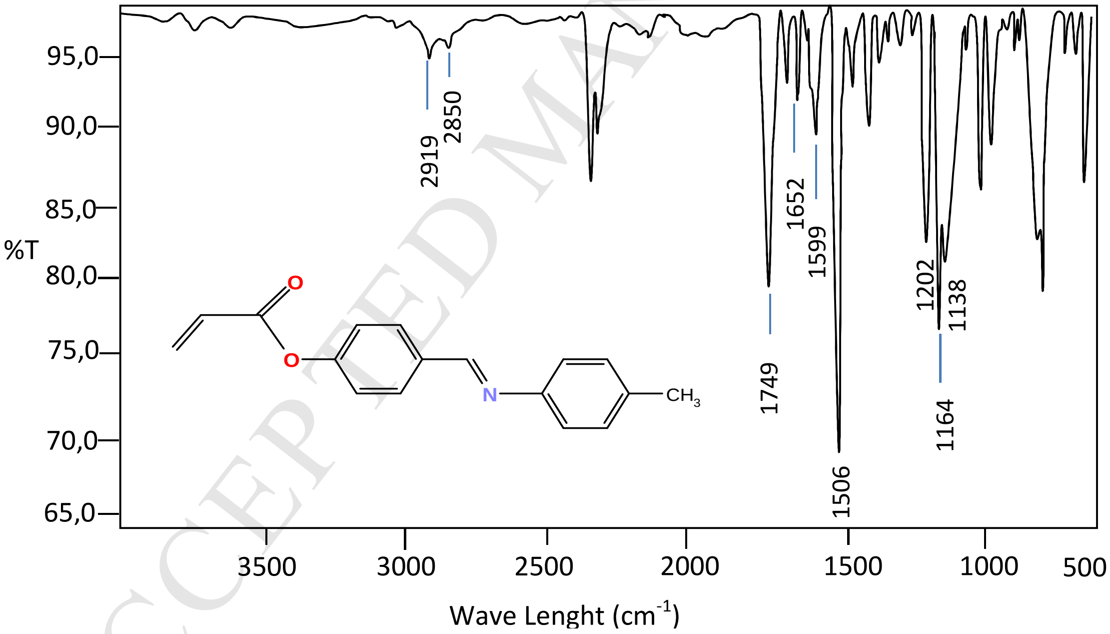


Figure 2. The IR spectrum for (*E*)-4-((4-Tolylimino)methyl)phenyl) acrylate, (**8**)

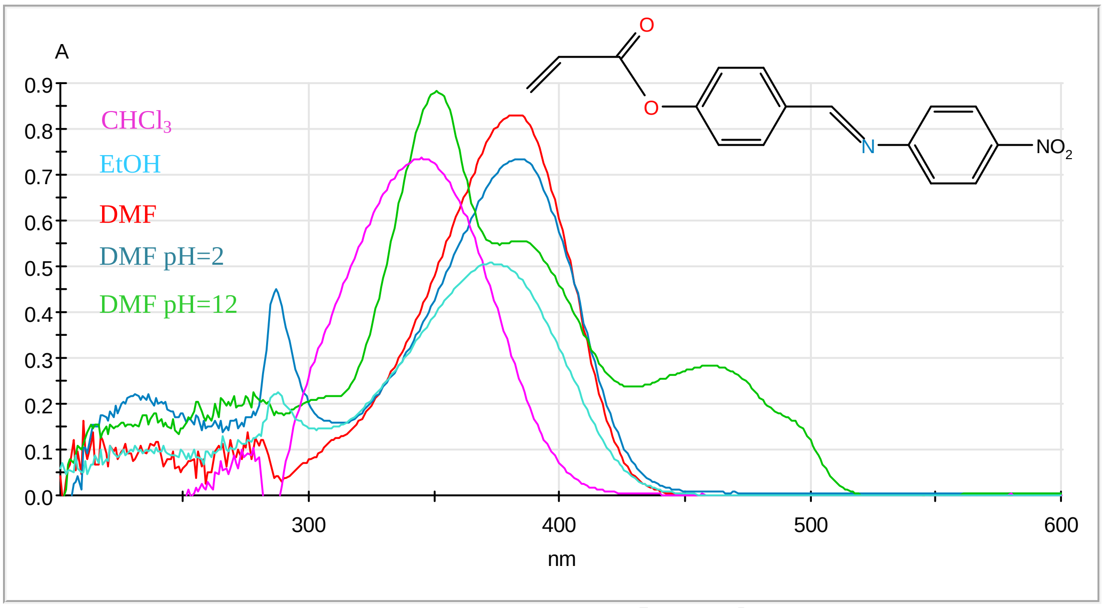


Figure 3. The UV-Vis spectrum for Synthesis of (*E*)-4-((4-Nitrophenyl-imino)methyl)phenyl) acrylate (**6**), in $CHCl_3$, EtOH, DMF, DMF (pH=1), DMF (pH=12) $1.0x10^{-5}$ M

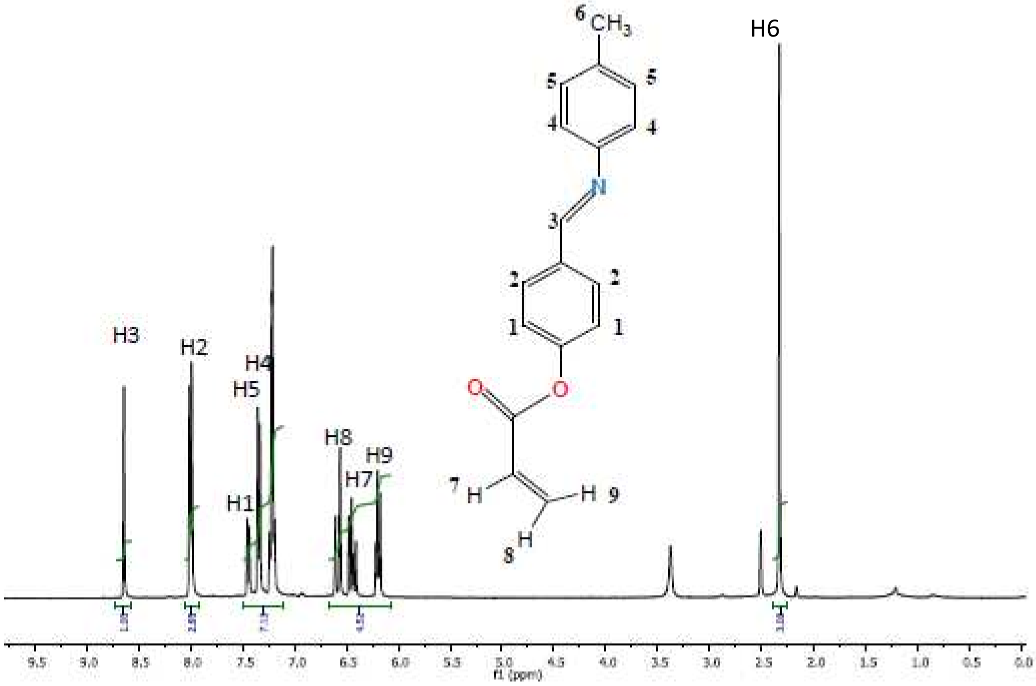


Figure 4. ^{1}H-NMR spectrum of the (*E*)-4-((4-Tolylimino)methyl)phenyl) acrylate, **8**

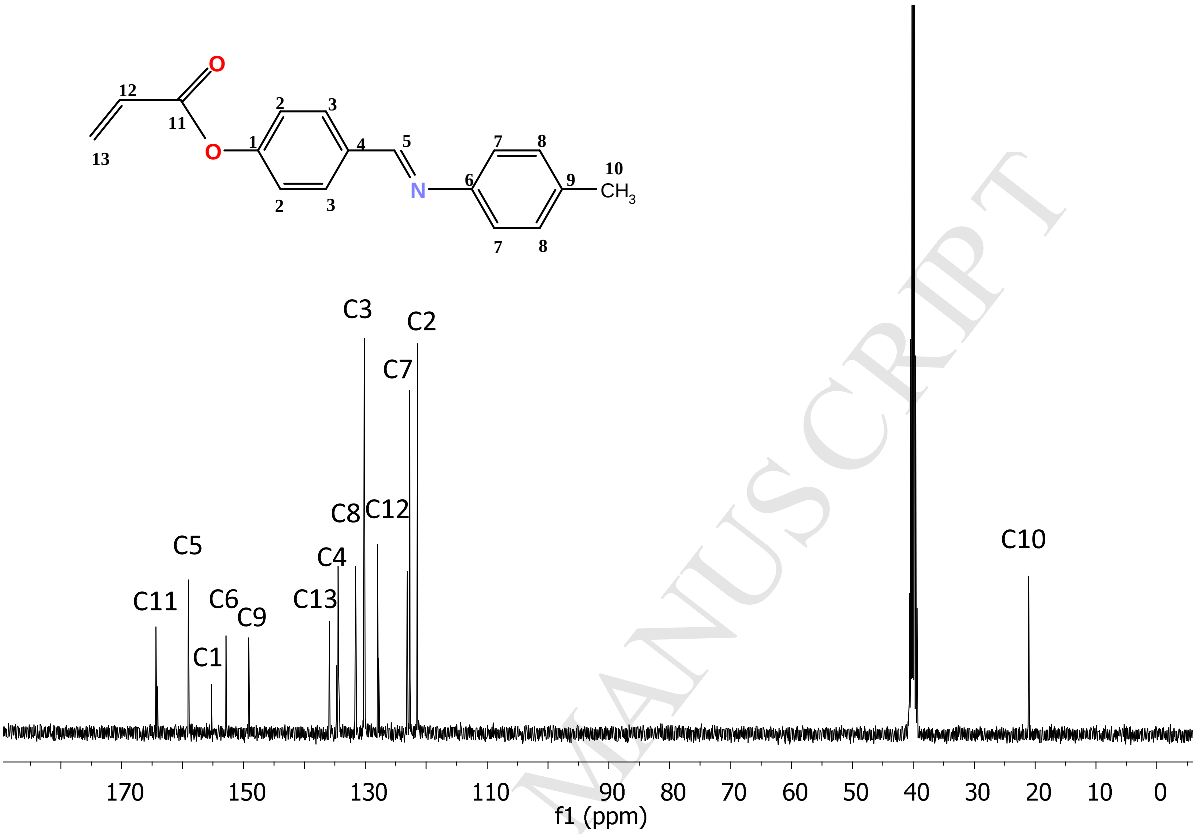


Figure 5. ^{13}C-NMR spectrum of the (*E*)-4-((4-Tolylimino)methyl)phenyl) acrylate, **8**

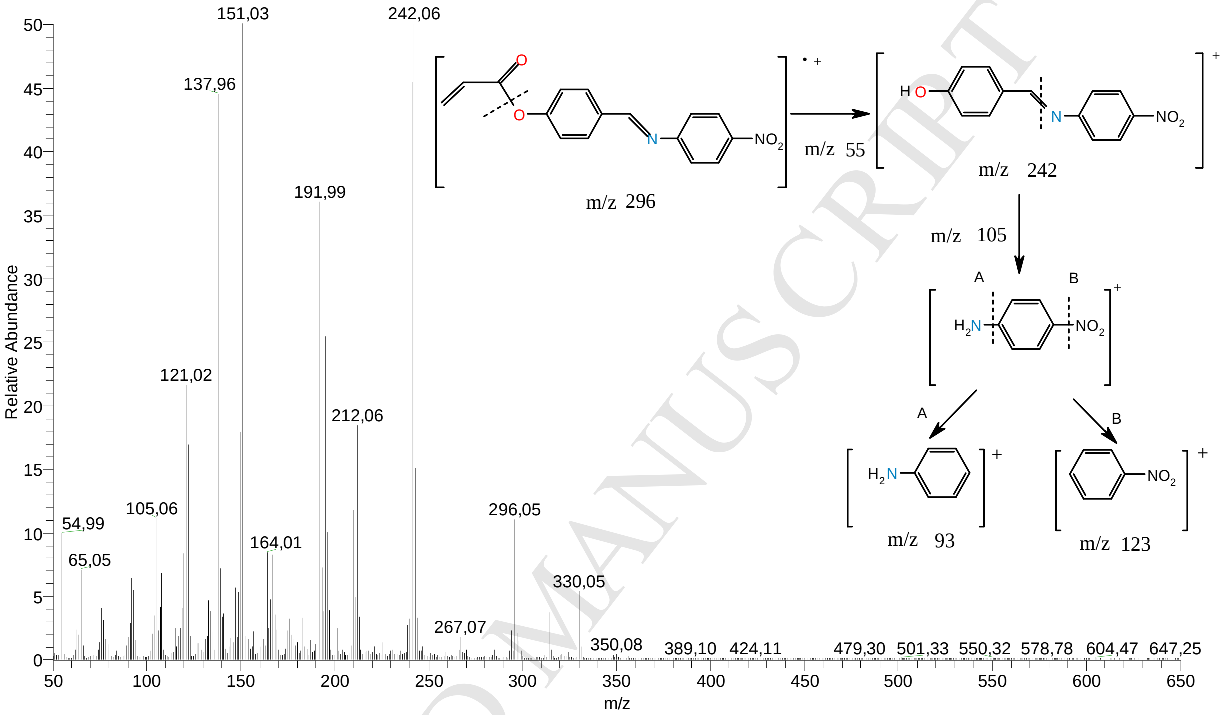


Figure 6. The mass spectrum and fragmentation pattern of (*E*)-4-((4-Nitrophenylimino)-methyl)phenyl) acrylate (**6**)

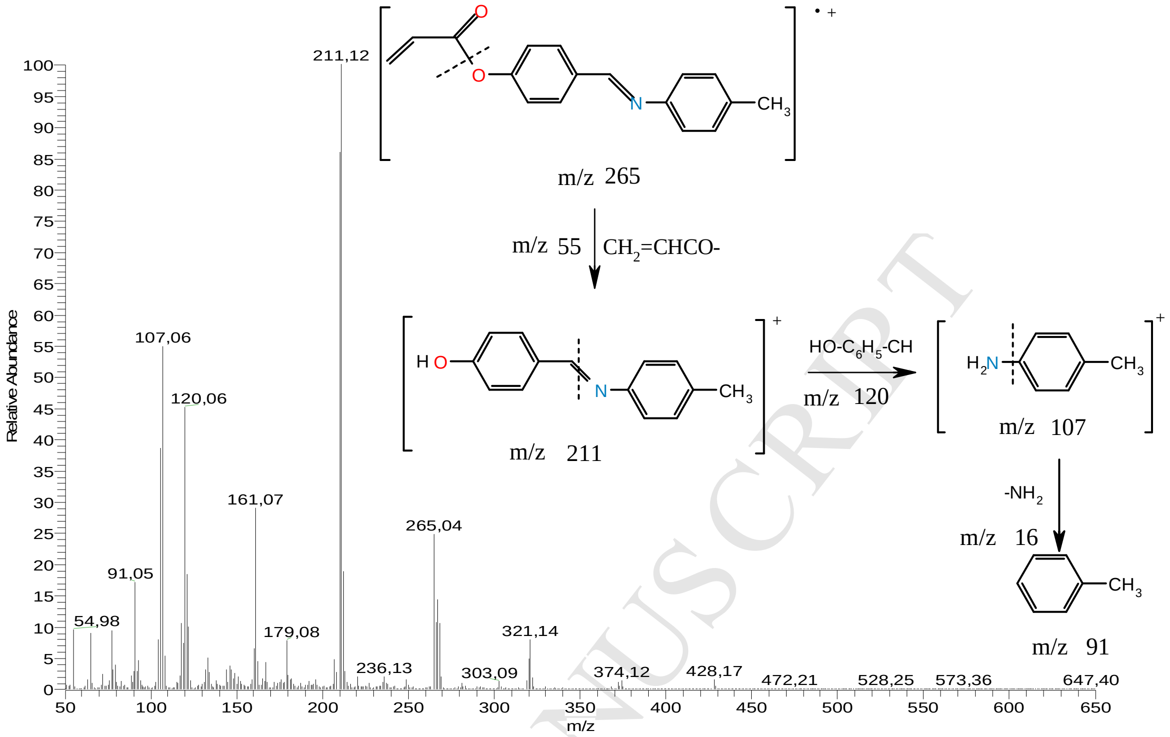


Figure 7. The mass spectrum and fragmentation pattern of (*E*)-4-((4-Tolylimino)methyl)phenyl) acrylate (**8**)

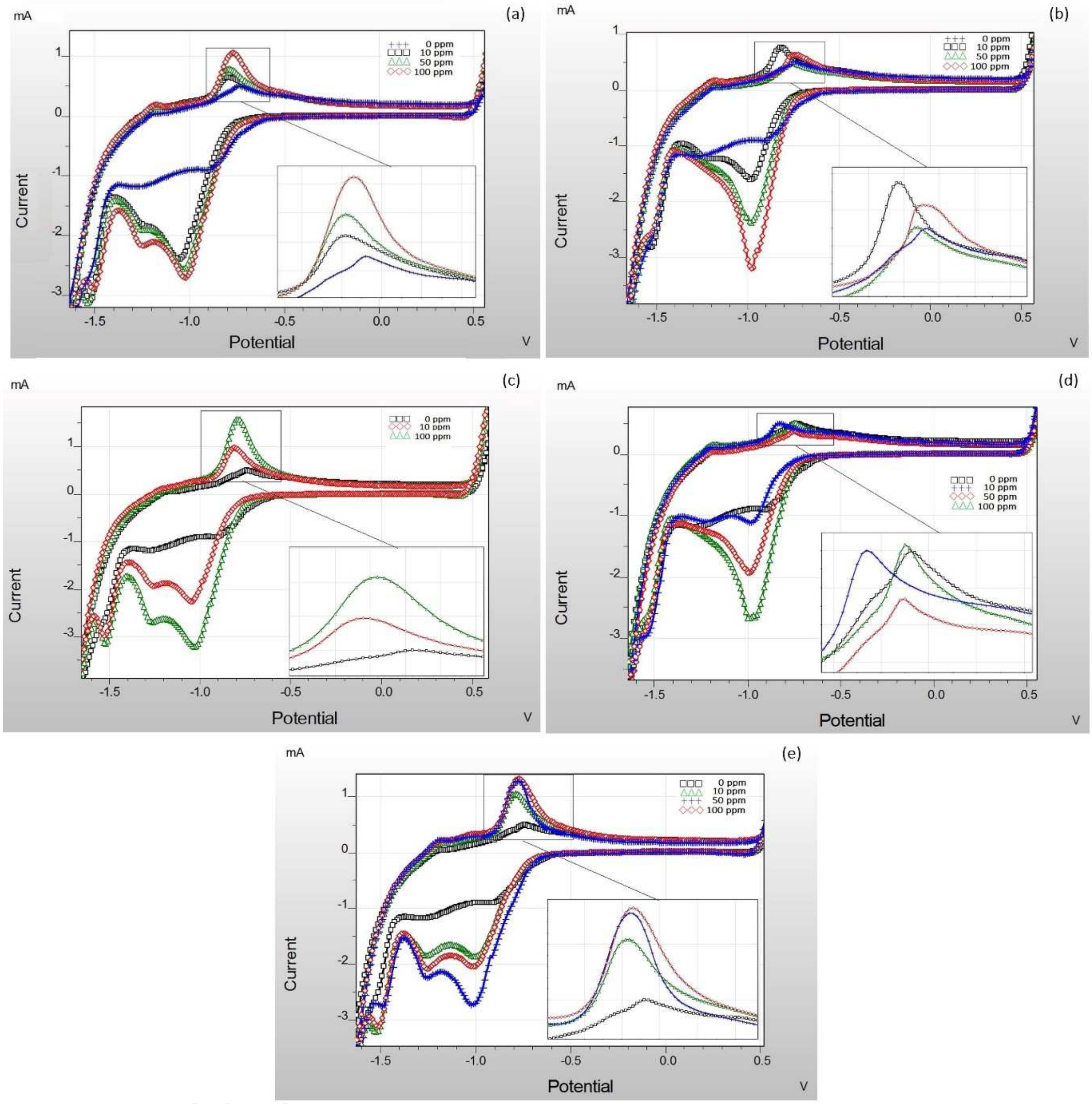


Figure 8. CV diagrams at 0, 10, 50 and 100 ppm concentration of (a); compound **2**, (b); compound **4**, (c); compound **6**, (d); compound **8** and (e); compound **10** in 0.10 M NaOH.

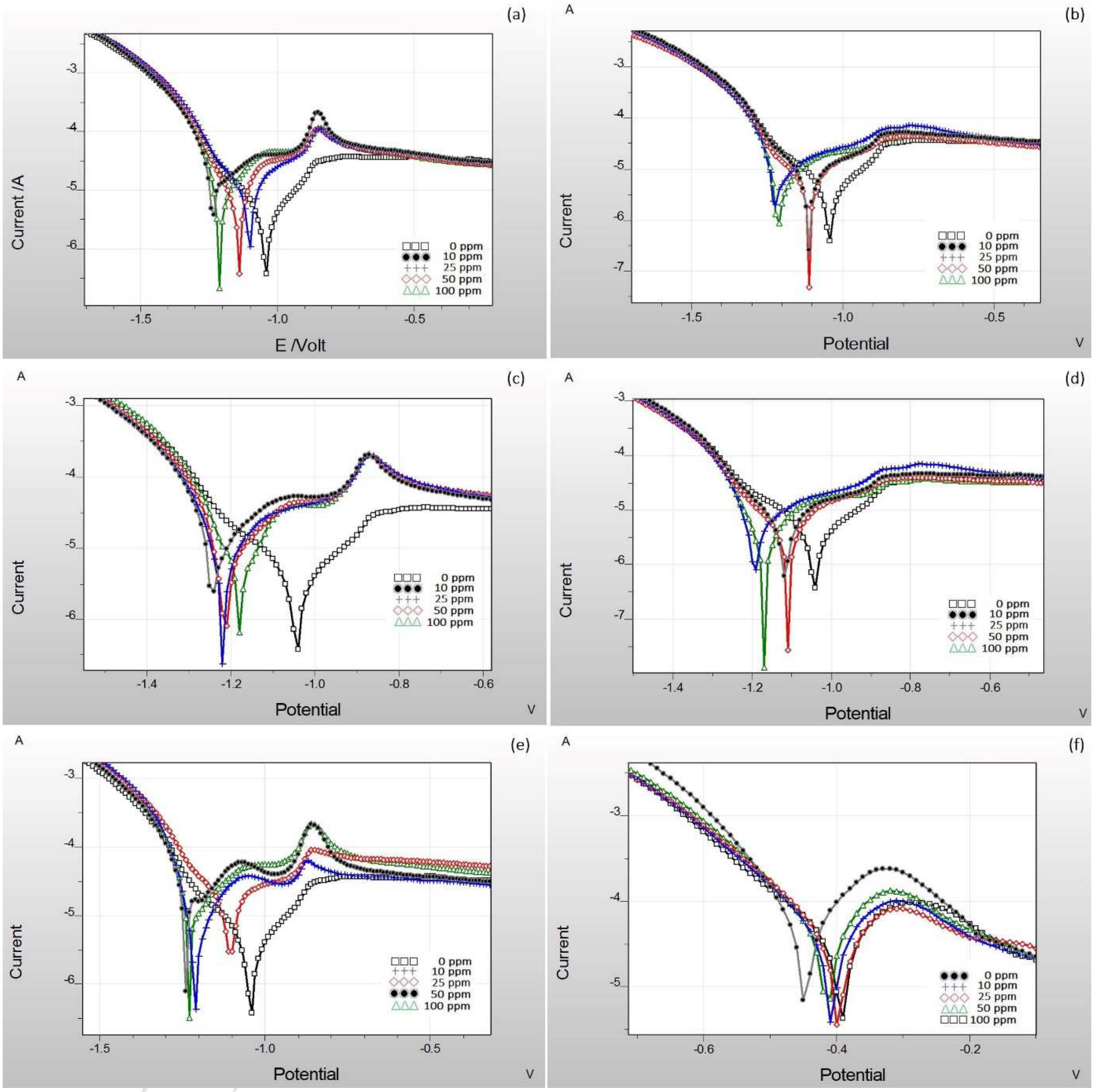


Figure 9. Tafel polarization curves on 0, 10, 25, 50 and 100 ppm concentrations of (a); compound **2**, (b); compound **4**, (c); compound **6**, (d); compound **8**, (e); compound **10** in 0.10 M NaOH and (f); compound **6** at H_2SO_4 solution.

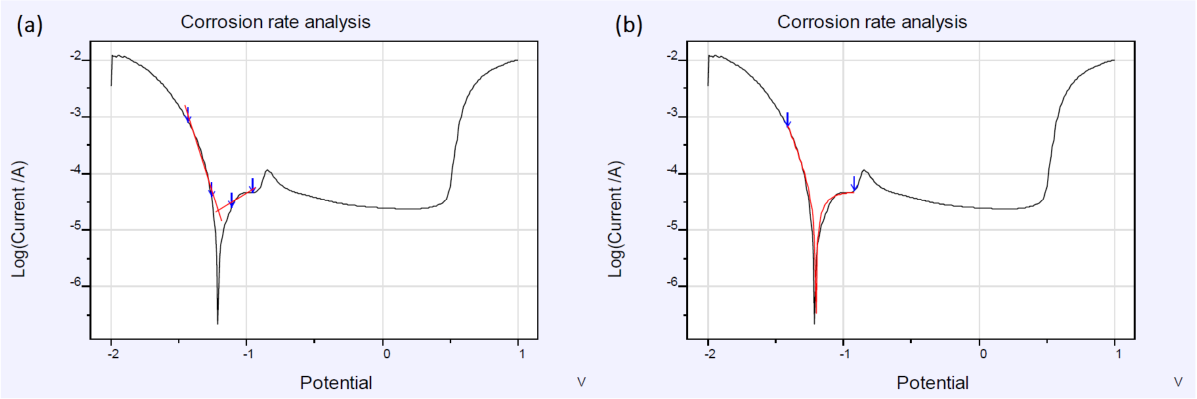


Figure 10. Corrosion rate calculation diagrams of 100 ppm compound 2, (a); Tafel polarization technique and (b); fit model technique.

Highlights

Novel schiff bases containing acryloyl moeity were synthesized.

Structural characterizations were performed by IR, UV-Vis, and NMR spectroscopy.

The inhibition efficiencies of these novel Schiff bases were investigated by cyclic voltammetry and Tafel extrapolation methods.

These compunds may have significance in synthesising novel organic materials.