Synthesis of Stable Aminothiophenes

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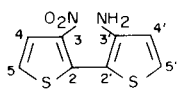
2- And 3-aminothiophenes are known to be unstable compounds which can be isolated only as salts under ordinary conditions (1-4). An exception is 2-aminobenzo[*b*]-thiophene (5), whose stability can be accounted for by the change in the electronic structure caused by the benzene ring. A few polysubstituted aminothiophenes have also been isolated as free bases, but their stability can be explained by the presence of an imino rather than of an amino structure in the molecule (5,6), the presence of electron withdrawing groups giving an higher stability (7,8).

We wish to report the synthesis and the properties of the two stable amines, 3-nitro-3′-amino-2,2′-bithienyl **1**,



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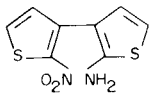

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and 2-nitro-2′-amino-3,3′-bithienyl **2** that we have obtained by chemical, or in low yields, by electrochemical (9) reduction of the corresponding dinitrobithienyls **3** and **4**.

The presence of the amino group is substantiated by the following results: the normal reactions of the amino group are observed. With **1**, for example, the acetamido derivative **5** and the diazonium tetrafluoroborate **6** are formed; a Schiff base **7** is obtained by condensation with 5-nitro-2-thiophenecarboxaldehyde. The nmr spectra of **1** and **2** show, in addition to the signals of the thiophene protons, a signal at δ 4.05 with a relative intensity of 2, which is due to the protons of the amino group. The bands which would correspond to an imino group are missing in the ir spectra, but the vibration bands characteristic of a primary amine are observed.

The remarkable stability of **1** and **2** is probably due to the existence of electronic interactions between the amino and the nitro groups. This hypothesis is supported by the fact that we could isolate 3,3′-diamino 2,2′-bithienyl and 3-amino 2,2′-bithienyl only as hydrochlorides (9); all our attempts to isolate the free base were unsuccessful.

EXPERIMENTAL

3-Nitro-3′-amino-2,2′-bithienyl (**1**).

To a solution of 5 g. of 3,3′-dinitrobithienyl in 1300 ml. of ethanol, freshly prepared Raney Ni (5 g.) (10) was added, and the mixture was hydrogenated at one atmosphere until no more hydrogen was consumed. The solution was filtered, concentrated *in vacuo* and chromatographed on silica gel (Merck 7734). Successive elution with chloroform-benzene (2:1), chloroform-benzene-acetone (10:5:1) and chloroform-benzene-acetone (5:5:1) gave in the following order: an azoxyderivative (9), 3-nitro-3′-amino-2,2′-bithienyl **1**, and 3,3′-diamino-2,2′-bithienyl.

Compound **1** was recrystallized from benzene-heptane (1:1) (580 mg., 13%) m.p. 90°; pK_a (water-ethanol 3:1) 2.40; ir ν max (potassium bromide): (cm^{-1}) 3430 and 3350 (asymmetric and symmetric NH_2 stretching); nmr (deuteriochloroform): δ = 7.65 (d, H_4), 7.22 (d, H_5), 6.64 (d, H_4'), 7.29 (d, H_5'), 4.05 (s, NH_2).

Anal. Calcd. for $C_8H_6N_2O_2S_2$: C, 42.46; H, 2.67; N, 12.38; O, 14.14; S, 28.34. Found: C, 42.10; H, 2.64; N, 12.26; O, 14.23; S, 28.11.

Hydrochloride, yellow solid; m.p. dec., 170° (acetic acid).

Anal. Calcd. for $C_8H_7ClN_2O_2S_2$: C, 36.57; H, 2.69; N, 10.66; O, 12.18; S, 24.41; Cl, 13.50. Found: C, 36.58; H, 2.75; N, 10.54; O, 12.36; S, 24.62; Cl, 13.43.

2-Nitro-2′-amino-3,3′-bithienyl (**2**).

This compound was prepared similarly from 2,2′-dinitro-3,3′-bithienyl (yield 2.5%) m.p. 112°; ir ν max (potassium bromide): (cm^{-1}) 3460 and 3390 (asymmetric and symmetric NH_2 stretching); nmr (deuteriochloroform): δ = 7.04 (d, H_4), 7.44 (d, H_5), 6.76 (d, H_4'), 6.51 (d, H_5'), 4.04 (s, NH_2).

Anal. Calcd. for $C_8H_6N_2O_2S_2$: C, 42.46; H, 2.67; N, 12.38; O, 14.14; S, 28.34. Found: C, 42.49; H, 2.78; N, 12.25; O, 14.29; S, 28.18.

3-Nitro-3′-acetamido-2,2′-bithienyl (**5**).

To a stirred solution of 200 mg. of **1** in 4 ml. of anhydrous benzene, 0.3 ml. of acetic anhydride was added slowly; the mixture was then stirred for 10 minutes at room temperature, poured on ice, and extracted with ether. Evaporation and recrystallization from benzene afforded 80 mg. (34%) of **5** (yellow crystals) m.p. 170°; ir ν max (potassium bromide): (cm^{-1}) 3250 (N-H), 1660 (C=O), 1500 and 1370 (NO_2); nmr (deuteriochloroform): δ = 7.30-7.80 (4d, H_4, H_5; H_4', H_5'); 7.55 (s, NH); 2.05 (s, CH_3).

Anal. Calcd. for $C_{10}H_8N_2O_3S_2$: S, 44.76; H, 3.01; N, 10.44; O, 17.89; S, 23.90. Found: C, 44.47; H, 3.05; N, 10.19; O, 17.83; S, 24.13.

3-Nitro-3′(5″-nitro-2″-thenylidene amino)-2,2′-bithienyl (**7**).

To a stirred solution of 226 mg. of **1** in ethanol was added dropwise 170 mg. of 5-nitro-2-thiophencarboxaldehyde dissolved in a small quantity of ethanol. The solution was refluxed for 4 hours. Recrystallization from benzene-heptane (2:1) of the solid obtained after cooling gave 100 mg. (30%) of **7** as red plates, m.p. 162-163°.

Anal. Calcd. for $C_{13}H_7N_3O_4S_3$: C, 42.73; H, 1.96; N, 11.50; O, 17.51; S, 26.32. Found: C, 41.99; H, 2.17; N, 11.73; O, 17.53; S, 26.97.

3-Nitro-3′-diazonium Fluoborate-2,2′-bithienyl (**6**).

To a solution of 113 mg. of **1** in 5 ml. of 34% fluoboric acid kept at 0° was slowly added a solution of 70 mg. of sodium nitrite in water. The mixture was maintained at 0° for ten minutes and then allowed to return to room temperature. The solvent was removed under reduced pressure, and the residue was recrystallized from water to give 125 mg. (76%) of **6** as yellow needles, m.p. 170-172°.

Anal. Calcd. for $C_8H_4N_3O_2S_2{}^{\circ}BF_4$: C, 29.56; H, 1.24; N, 12.93; S, 19.73; F, 23.39. Found: C, 29.61; H, 1.41; N, 12.95; S, 19.81; F, 23.72.

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