ISSN 1070-3632, Russian Journal of General Chemistry, 2014, Vol. 84, No. 9, pp. 1863–1865. © Pleiades Publishing, Ltd., 2014.
Original Russian Text © M. Yekhlef, M.L. Petrov, L.M. Pevzner, 2014, published in Zhurnal Obshchei Khimii, 2014, Vol. 84, No. 9, pp. 1580–1582.

LETTERS TO THE EDITOR

New Method of Synthesis of 2-Naphthylthioacetamides from 4-(2-Naphthyl)-1,2,3-thiadiazole

M. Yekhlef [a], M. L. Petrov[b], and L. M. Pevzner[b]

[a] *Department of Chemistry, Faculty of Sciences, University of Jijel, Jijel, Algeria*
[b] *St. Petersburg State Technological Institute (Technical University), Moskovskii pr. 26, St. Petersburg, 190013 Russia*
e-mail: mlpetrov@lti-gti.ru

Received July 7, 2014

Keywords: 1,2,3-thiadiazole, 2-naphthylthiacetamides, [1,3]dithiol, synthesis

DOI: 10.1134/S1070363214090382

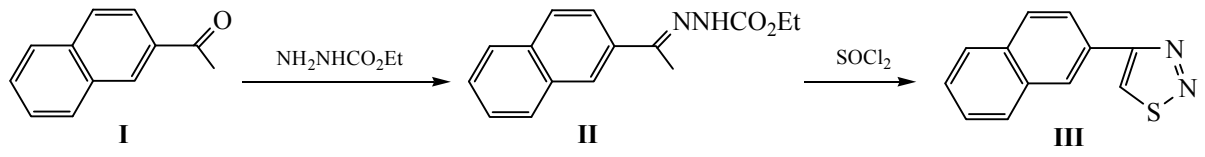
Piperidylamide [1] and morpholylamide [2] of 2-naphthylthioacetic acid and their derivatives have been well known. Piperidylamide of 2-naphthylthioacetic acid can be obtained by the Willgerodt–Kindler reaction [1] from 2-acetylnaphthalene, sulfur and pipridine or by treating piperidylamide of 2-naphthylacetic acid with Lawesson reagent [3]. Morpholylamide of 2-naphthylthioacetic acid can be obtained only by the Willgerodt–Kindler reaction [2, 4].

Amides of 2-naphthylthioacetic acids are widely used in the synthesis of naphthalene derivatives. For example, the hydrolysis of 2-morpholylamide of 2-naphthylthioacetic acid resulted in 2-naphthylacetic acid [2]. The hydrogenation of piperidylamide of 2-naphthylthioacetic acid in the presence of Raney nickel provided the corresponding amine [1]. Reaction of morpholylamide of 2-naphthylthioacetic acid with dimethyl sulfoxide and methyl iodide afforded thioesters of 2-naphthylthioacetic acid [5]. Successive action of methyl iodide and potassium *tert*-butoxide on morpholylamide of 2-naphthylthioacetic acid led to the formation of the corresponding ketene-*S*,*N*-acetals [6]. Copper-catalyzed α-oxidation of 2-naphthylthioacetamides is an effective approach towards the synthesis of α-ketonaphthylthioamides [7]. Thio-Claisen rearrangement of the reaction products obtained from propargyl bromide or ω-bromoketones and morpholylamide of 2-naphthylthioacetic acid gave rise to polysubstituted thiophenes [4, 8].

In this work, we developed a new method for the synthesis of dialkylamides of 2-naphthylthioacetic acid starting from readily available 4-(2-naphthyl)-1,2,3-tiadiazole **III**. The latter was prepared by the modified Kirmse procedure [9] by reacting 2-naphthylmethylketone **I** with ethoxycarbonylhydrazine followed by treating the intermediately formed ethoxycarbonylhydrazone **II** with thionyl chloride (Scheme 1).

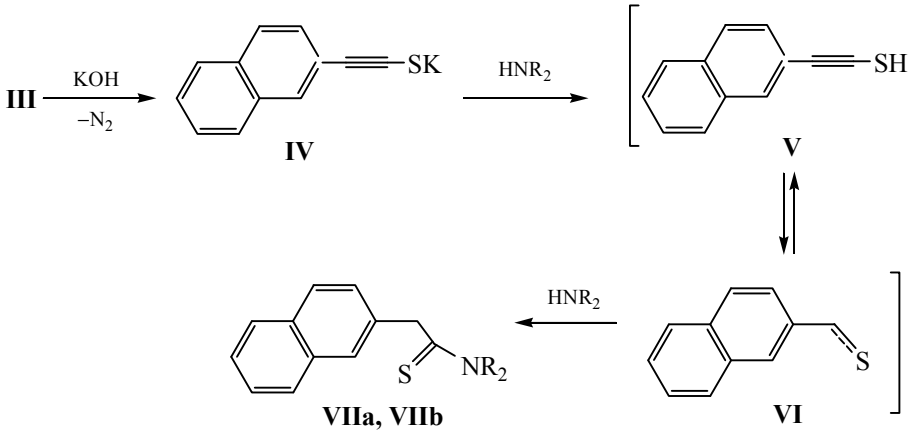
Under the action of potassium hydroxide in anhydrous dioxane 4-(2-naphthyl)-1,2,3-thiadiazole **III** decomposes readily with the release of nitrogen and the formation of potassium 2-(2-naphthyl)ethynethiolate **IV**. Further treatment of the reaction mixture with an excess of a secondary amine gave rise to the corresponding amides of 2-naphthylthioacetic acid **VIIa** and **VIIb**. The reaction probably proceeded through the intermediate formation of a mixture of tautomers, 2-naphthylethynethiol **V** and 2-naphthylthioketene **VI** (Scheme 2).

Scheme 1.



I **II** **III**

Scheme 2.



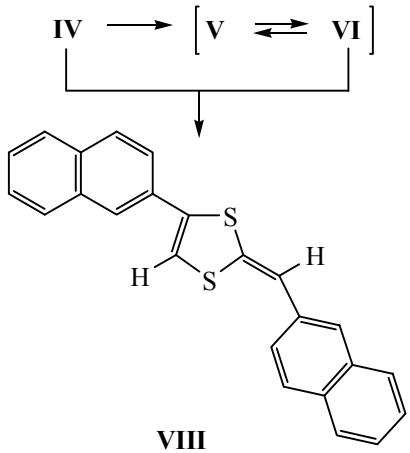
NR_2 = morpholyl (**a**), piperidyl (**b**).

Structures of the resulting thioamides **VIIa** and **VIIb** were confirmed by ^1H and ^{13}C NMR spectra and by comparison with the published data [1, 2].

According to TLC, the formation of thioamides **VIIa** and **VIIb** was accompanied by generating 2-(2-naphthyl)methylene-4-(2-naphthyl)-2*H*-1,3-dithiol **VIII** as the protonation product of potassium 2-(2-naphthyl) ethynylthiolate **IV**. This dimer **VIII** of thioketene **V** was easily obtained by carrying out the reaction in the absence of amine and in the presence of ethanol (Scheme 3).

Structure of [1,3]dithiol **VIII** was confirmed by NMR spectroscopy and by comparison with the published data [9]. This compound has been first prepared by photolysis of 4-(2-naphthyl)-1,2,3-thiadiazole **III** [9].

Scheme 3.



VIII

Ethoxycarbonylhydrazone of 2-naphthyl methyl ketone (II). A mixture of 5 g (29.4 mmol) of 2-naphthyl methyl ketone **I** [10], 3.52 g (33.84 mmol) of ethoxycarbonylhydrazine, 20 mL of ethanol, and 4 drops of acetic acid was refluxed for 2 h, and then kept at room temperature. The precipitate was filtered off, washed with 10 mL of ethanol, and dried. Yield 4.9 g (90%), colorless crystals, mp 128°C (mp 129°C [11]), R_f 0.56 (hexane–EtOAc, 7 : 5). ^1H NMR spectrum (DMSO-d_6), δ, ppm: 1.30 t (3H, $OCH_2\underline{CH_3}$, *J* 8 Hz), 2.46 s (3H, CH_3), 4.24 q (2H, CH_2, *J* 8 Hz), 7.51–7.54 m (2H, Ar), 7.87–7.97 m (3H, Ar), 8.19–8.23 m (2H, Ar), 9.27 br. s (1H, NH). ^{13}C NMR spectrum (DMSO-d_6), δ_C, ppm: 12.27 (CH_3), 14.11 ($OCH_2\underline{CH_3}$), 60.76 (CH_2); 123.82, 125.80, 126.52, 127.54, 128.50, 133.66, 136.18 (Ar), 147.58 (C=O), 154.00 (C=N).

4-(2-Naphthyl)-1,2,3-thiadiazole (III). A mixture of 5 g (19.5 mmol) of hydrazone **II**, 40 mL of chloroform and 5 mL of freshly distilled thionyl chloride was stirred at 60°C for 1 h. After cooling to 20–25°C chloroform and an excess of thionyl chloride were evaporated. The residue was washed with water, dried, and recrystallized from 20 mL of methanol. Yield 4.25 g (85%), brown crystals, mp 114°C (mp 115°C [9]), R_f 0.57 (EtOAc–hexane, 1 : 4). ^1H NMR spectrum (DMSO-d_6), δ, ppm: 7.59–7.61 m (2H, Ar), 7.99–8.11 m (3H, Ar), 8.31–8.29 m (1H, Ar), 8.77 m (1H, Ar), 9.53 s (H^5, thiadiazole). ^{13}C NMR spectrum ($CDCl_3$), δ_C, ppm: 124.89 (C^5, thiadiazole); 126.60, 126.79, 126.87, 127.80, 128.47, 128.90, 131.99, 133.60 (Ar), 133.74 (C^4, thiadiazole).

Morpholylamide of 2-naphthylthioacetic acid (VIIa). To a solution of 0.38 g (1.79 mmol) of

thiadiazole **III** in 15 mL of dioxane was added 0.108 g (1.94 mmol) of finely ground KOH. The reaction mixture was stirred for 5 min until gas evolution ceased. Then to the reaction mixture a solution of 1.61 g of (18.57 mmol) of morpholine in 7 mL of dioxane was added. The mixture was refluxed for 5 h, washed with water (3 × 30 mL), and evaporated. The residue was washed with water and dried. Yield 0.35 g (78%), yellow crystals, mp 107–108°C (mp 108–109°C [2]), R_f 0.6 (EtOAc–hexane, 1 : 2). ^{1}H NMR spectrum (DMSO-d_6), δ, ppm: 3.44 m and 3.72 m ($CSNCH_2\underline{CH_2}$), 3.81 m and 4.34 m ($CSNCH_2$), 4.57 s (CH_2CS), 7.50–7.52 m (2H, Ar), 7.58–7.60 m (1H, Ar), 7.85–7.91 m (4H, Ar). ^{13}C NMR spectrum ($CDCl_3$), δ_C, ppm: 49.98, 50.86 (CH_2N), 65.93 ($\underline{C}H_2CS$), 66.03 (CH_2O); 125.74, 125.90, 128.41, 127.82, 128.23, 133.69 (Ar), 199.42 (CS).

Piperidylamide of 2-naphthylthioacetic acid (VIIb) was obtained similarly from 0.4 g (1.89 mmol) of thiadiazole **III**, 0.11 g (1.94 mmol) of KOH, 3.7 g (43.54 mmol) of piperidine, and 24 mL of dioxane. Yield 0.25 g (48%), yellow crystals, mp 95–96°C (mp 90–92°C [1]), R_f 0.2 (EtOAc–hexane, 1 : 2). ^{1}H NMR spectrum (DMSO-d_6), δ, ppm: 2.90 m ($CSNCH_2\cdot\underline{CH_2CH_2}$), 3.87 m and 4.30 m ($CSNCH_2$), 4.54 s ($CH_2CS$), 7.50–7.52 m (2H, Ar), 7.58–7.60 m (1H, Ar), 7.85–7.91 m (4H, Ar). ^{13}C NMR spectrum ($CDCl_3$), δ_C, ppm: 23.59, 25.11 ($CSNCH_2\underline{CH_2CH_2}$); 50.51, 50.91 ($CH_2N$), 59.66 ($\underline{C}H_2CS$); 125.64, 126.12, 126.38, 127.56, 128.10, 132.51, 133.72 (Ar); 197.87 (CS).

2-(2-Naphthyl)-4-(2-naphthyl)methylene[1,3]dithiol (VIII). To a solution of 0.12 g (2.14 mmol) of KOH in 2 mL of ethanol was added a solution of 0.3 g (1.41 mmol) of thiadiazole **III** in 10 mL of dioxane. The reaction mixture was refluxed for 4 h. After evaporating, the residue was washed subsequently with water and diethyl ether, and dried. Yield 0.09 g (86%), yellow powder, mp 261–262°C (mp 258–260°C [9]), R_f 0.88 (EtOAc–hexane, 1 : 4). ^{1}H NMR spectrum (DMSO-d_6), δ, ppm: 6.94 s ($CH{=}CS_2$), 7.37–7.58 m (7H, Ar), 7.81–8.02 m (7H, Ar), 8.35 s (SCH=CS). ^{13}C NMR spectrum ($CDCl_3$), δ_C, ppm: 123.95 ($CH{=}CS_2$), 124.97 ($S\underline{CH}{=}CS$); 127.00, 127.19, 127.46, 127.99, 128.58, 129.06, 129.46, 131.6, 132.91, 133.24 (Ar), 133.72 (SCH=$\underline{C}$S), 134.47 (=CS_2).

Melting points were determined on a Boëtius heating block. ^{1}H (400 MHz) and ^{13}C (100 MHz) NMR spectra were recorded on a Bruker AMX-400 spectrometer. The reaction progress was monitored by TLC on Silufol UV-254 plates detecting with UV irradiation and iodine vapor.

ACKNOWLEDGMENTS

This work was supported by the Ministry of Education and Science of Russian Federation in the frame of the basic part of the Governmental contract.

REFERENCES

1. Kornfeld, E.C., *J. Org. Chem*., 1951, vol. 16, no. 1, p. 131. DOI: 10.1021/jo01141a700.
2. Schwenk, E. and Bloch, E., *J. Am. Chem. Soc*., 1942, vol. 64, no. 12, p. 3051. DOI: 10.1021/ja01264a700.
3. Lee, V.J., Curran, W.V., and Fields, T.F., *J. Heterocycl. Chem*., 1988, vol. 25, p. 1873. DOI: 10.1002/jhet.5570250651.
4. Moghaddam, F.M. and Zali-Boinee, H., *Tetrahedron Lett*., 2003, vol. 44, p. 6253. DOI: 10.1016/S0040-4039(03)01548-X.
5. Darabi, H.R., Aghapoor, K., and Tabar-Heidar, K., *Monat. Chem*., 2004, vol.135, p. 79. DOI: 10.1007/s00706-013-0998-3.
6. Gompper, R. and Elser, W., *Lieb. Ann. Chem*., 1969, vol. 725, p. 64. DOI: 10.1002/jlac.19697250109.
7. Moghaddam, F.M., Mirjafary, Z., Saeidian, H., and Javanr, M.J., *Synlett*, 2008, no. 6, p. 892. DOI: 10.1055/s-2008-1042925.
8. Moghaddam, F.M. and Zali-Boinee, H., *Tetrahedron*, 2004, vol. 60, p. 6085. DOI: 10.1016/j.tet.2004.05.072.
9. Kirmse, W. and Horner, L., *Lieb. Ann. Chem*., 1958, vol. 614, p. 4. DOI: 10.1002/jlac.19586140103.
10. Sucerearu, M., Finaru, A., Raicopol, M., Enache, R., and Rosca, S.L., *Lett. Org. Chem*., 2011, vol. 8, no. 10, p. 690.
11. Dang, T.-T., Albrecht, U., Gerwien, K., Siebert, M., and Langer, P., *J. Org. Chem*., 2006, vol. 71, no. 6, p. 2293. DOI: 10.1021/jo052329e.